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The black flies (Diptera: Simuliidae) of Flores and Timor, Indonesia

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Abstract: A faunistic survey of the family Simuliidae in Flores and Timor, Indonesia, yielded a total of nine species comprising four new, four named, and one unidentified species. All belong to the genus *Simulium* Latreille s. l. and four subgenera, *Gomphostilbia* Enderlein (4 spp.), *Nevermannia* Enderlein (1 sp.), *Simulium* Latreille s. str. (3 spp.) and *Wallacellum* (1 sp.). Descriptions for all new species are given.

Key words: *Simulium*, Simuliidae, Indonesia, new species, Flores, Timor

The black flies (Diptera: Simuliidae) of the Sunda Archipelago, Indonesia, have been little studied. In total, 37 species were known, of which 11 species were reported only from Java, 15 only from Sumatra, 10 from Java and Sumatra, and one from Java, Sumatra and Bali (Takaoka and Davies, 1996; Takaoka et al., 2000).

The present paper reports the results of examination of adults reared from pupae, pupae and larvae collected in 1993 by one of us (H.T.) in Flores and Timor, located in the eastern part of the Sunda Archipelago. A total of nine simuliid species were recognized, comprising four new, four named, and one unidentified species. All belong to the genus *Simulium* Latreille s. l. and four subgenera, *Gomphostilbia* Enderlein (4 spp.), *Nevermannia* Enderlein (1 sp.), *Simulium* Latreille s. str. (3 spp.) and *Wallacellum* Takaoka (1 sp.). Descriptions for all new species are given.

The terms for morphological features used here follow those of Takaoka (2003). Holotype and paratype specimens of the new species are deposited at the Depart-

ment of Infectious Disease Control, Faculty of Medicine, Oita University, Oita, Japan.

SPECIES ACCOUNTS

Simulium (Gomphostilbia) sundaicum Edwards

Simulium (Eusimulium) sundaicum Edwards, 1934: 122-124 (female, male, pupa and larva).
Simulium (Gomphostilbia) sundaicum: Crosskey, 1973: 425; Takaoka and Davies, 1996: 19-22 (female, male, pupa and larva); Takaoka et al., 2000: 161-162.

SPECIMENS EXAMINED. 2 females, 2 pupal exuviae, 11 mature larvae and 39 immature larvae, collected from an irrigation channel (width 0.5-1.0 m, exposed to sun, water temperature 19.5°C, altitude 1,070 m) in a rice field, near the town of Ruteng; 7 females, 8 males, 6 pupae, 20 pupal exuviae, 5 mature larvae and 10 immature larvae, collected in a river

(width 10–20 m, exposed to sun, water temperature 22.0°C, altitude 890 m), Waegarit, Ruteng; 1 female and 5 immature larvae, collected from a stream (width 3.0 m, exposed to sun, altitude 1,050 m), Wae Locale, near the town of Ruteng; 1 female, 3 males, collected from a slow-flowing ditch (width 0.2 m, water temperature 17.0°C, exposed to sun, altitude 1,250 m), Waso, Ruteng; all in Flores and collection date, 12.IX.1993.

ECOLOGICAL NOTES. The pupae and larvae of this species were collected from trailing grasses, twigs, fine roots and fallen leaves in various watercourses from small streams to a wide river. Associated species were *S. (N.) aureohirtum* Brunetti, *S. (S.) nebulicola* Edwards and *S. (S.) timorense* sp. nov. and *S. (S.) upikae* Takaoka and Davies and *S. (W.)* sp.

DISTRIBUTION. Flores (new record), Java and Sumatra.

REMARKS. This species was originally described from female, male, pupal and larval specimens collected from Java (Edwards, 1934). The morphological characteristics of the present specimens agree with those redescribed by Takaoka and Davies (1996) except for the larval rectal organ with 1–3 short somewhat thumb-like secondary lobules per each lobe (cf., 5–7 finger-like secondary lobules per lobe in the larvae from Java). *Simulium (G.) sundaicum* was assigned to the *batoense* species-group (Takaoka and Davies, 1996).

***Simulium (Gomphostilbia) floresense*
sp. nov.**

DESCRIPTION. Female. Body length 2.5–2.7 mm. **Head.** Frons blackish-brown, thinly white pruinose, very slightly shiny at certain angle of light, densely covered with whitish-yellow fine hairs intermixed with several dark hairs along each lateral margin; frontal ratio 1.67–1.78 : 1.00 : 3.42–3.67; frons-head ratio 1.0 : 6.7. Fronto-ocular area (Fig. 1A) well develop-

ed, elongate, directed laterally and upwardly. Clypeus dark brown, thinly white pruinose, slightly shiny at certain angle of light, densely covered with whitish-yellow fine hairs intermixed with 3 or 4 dark stout hairs along each lateral margin. Labrum 0.63 times as long as clypeus. Antenna composed of 2+9 segments, light brown except scape, pedicel and basal 1/2 of 1st flagellar segment yellowish when viewed dorsally or posteriorly; antenna more extensively yellowish from scape to 2nd or 3rd flagellar segment when viewed ventrally or anteriorly. Maxillary palp with 5 segments, proportional lengths of 3rd, 4th, and 5th segments 1.0 : 1.0 : 2.6; 3rd segment (Fig. 1B) somewhat swollen; sensory vesicle (Fig. 1B) elongate, 0.4–0.5 times as long as 3rd segment, and with medium or large opening. Maxilla with 10 inner and 13 or 14 outer teeth. Mandible with 26–28 inner and 7 or 8 outer teeth though outer margin not serrated near apex. Cibarium (Fig. 1C) medially with short broad sclerotized projection folded forwardly from posterior margin, and with well-sclerotized longitudinal ridge medially. **Thorax.** Scutum medium to dark brown except anterolateral calli light brown, thinky white pruinose, with 3 faint longitudinal dark vittae, densely covered with whitish-yellow recumbent hairs. Scutellum medium brown, with whitish-yellow short hairs and several dark long upright hairs posteriorly. Postnotum dark brown, thinly white pruinose, bare. Pleural membrane bare. Kepisternum with dark hairs as well as pale hairs. **Legs.** Foreleg: coxa and trochanter whitish-yellow; femur dark yellow to light brown with apical cap medium brown; tibia whitish except apical 1/4 dark brown and along inner margin narrowly light brown; tarsus brownish-black; basitarsus slightly dilated, 6.7 times as long as its greatest width. Midleg: coxa blackish-brown; trochanter whitish-yellow; femur light brown except basal 1/4 whitish-yellow and apical cap medium brown; tibia whitish-yellow on basal 1/3 with light brown subbasal patch, and light to medium brown on apical 2/3; tarsus dark brown except basal 1/2 or a little more whitish-yellow. Hind leg: coxa medium brown; trochanter whitish-yellow; femur medium brown except base whitish-yellow and apical cap dark brown; tibia (Fig. 1D) whitish-yellow to yellow on basal 2/5 with light brown subbasal patch and medium to dark brown on apical 3/5; tarsus dark brown to blackish-

brown except basal 3/5 of basitarsus and basal 1/2 of 2nd segment whitish; basitarsus (Fig. 1 E) nearly parallel-sided, 6.3 times as long as wide, and 0.60 and 0.50 times as wide as greatest widths of hind tibia and femur, respectively; calcipala and pedisulcus well developed. Claw (Fig. 1F) with large basal tooth 0.5 times as long as claw. **Wing.** Length 2.1–2.3 mm. Costa with 2 parallel rows of short spines and hairs. Subcosta haired except near apex bare.

Hair tuft of stem vein mostly yellow. Basal portion of radius fully haired; R_1 with dark spinules as well as hairs; R_2 with hairs only. Basal cell absent. **Abdomen.** Basal scale dark yellow to light brown, with fringe of yellow hairs. Dorsal surfaces of segments 2–4 medium to dark brown though basal 1/2 of 2nd segment somewhat lighter, and brownish-black on segments 5–9, covered with dark and pale short hairs; tergite 2 somewhat whitish

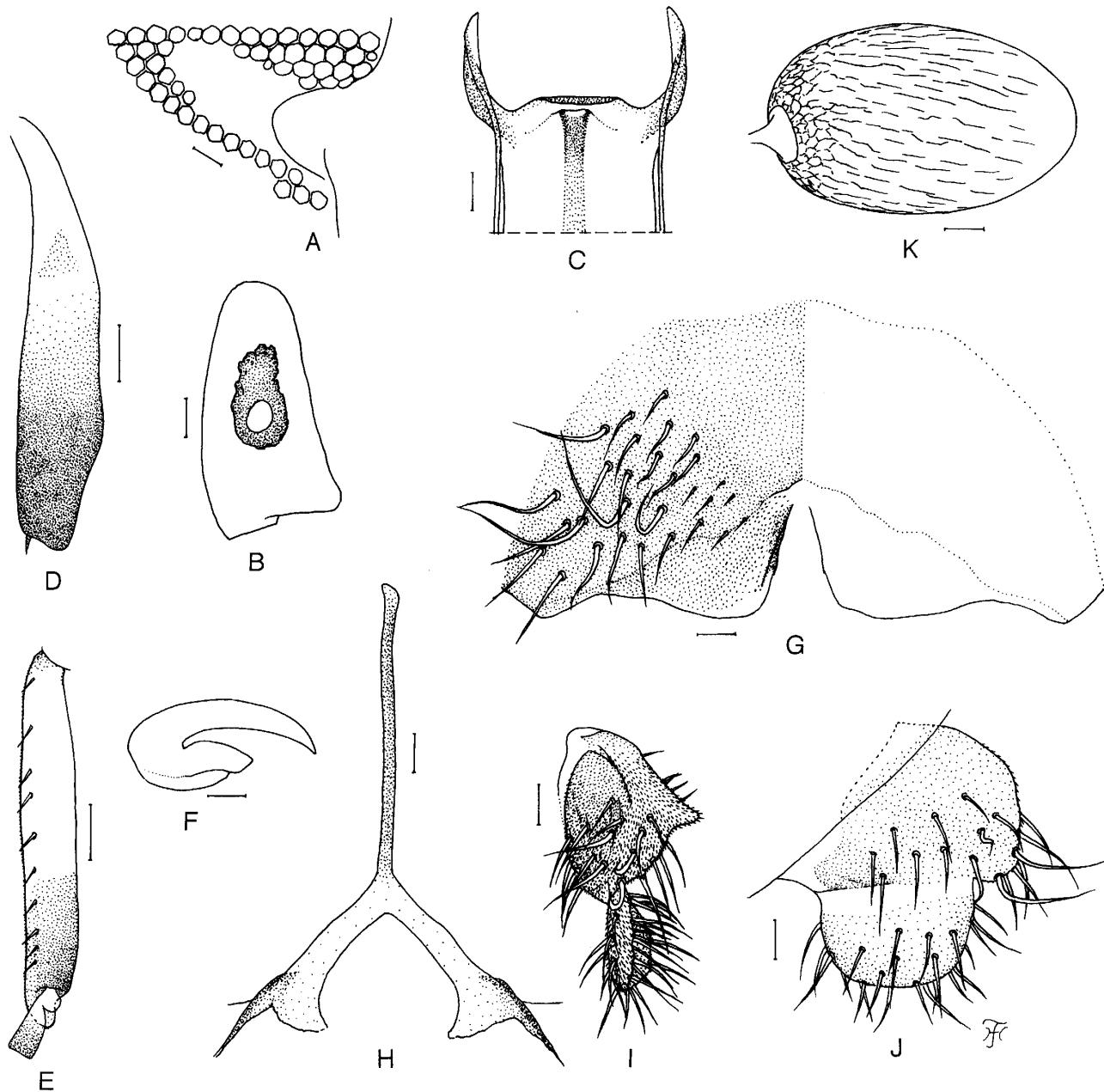


Fig. 1. Female of *Simulium (Gomphostilbia) floresense* sp. nov. A, fronto-ocular area (right side; front view); B, 3rd segment of maxillary palp with sensory vesicle (right side, front view); C, cibarium; D, hind tibia (left side, outer view); E, hind basitarsus and 2nd tarsal segment (left side, outer view); F, claw; G, 8th sternite and ovipositor valves (ventral view); H, genital fork; I and J, paraprocts and cerci (right side; I, ventral view; J, lateral view); K, spermatheca. Scale bars. 0.1 mm for D and E; 0.03 mm for A; 0.02 mm for B, C and G–K; 0.01 mm for F.

pruinose and shiny at certain angle of light; tergites 6–9 shiny. Sternal plate of 7th abdominal segment undeveloped. **Genitalia.** Sternite 8 (Fig. 1G) bare medially, furnished with 18–29 stout hairs as well as 4–7 short setae on each side. Ovipositor valves (Fig. 1G) triangular, rounded posteromedially, thin, membranous except inner margin narrowly sclerotized, covered with 0–2 short setae as well as numerous microsetae except posteromedial corner bare and transparent; inner margins moderately separated from each other. Genital fork (Fig. 1 H) inverted-Y-shaped, arms of moderate width, strongly folded posterolaterally and each with thin triangular lobe directed posteromedially. Paraproct (Fig. 1I, J) short, somewhat protruding ventrally beyond level of cercus, 0.77 times as long as its width in lateral view, and covered

with 14–18 stout hairs on ventral and outer surfaces; anteroinner surface with 5–7 sensilla. Cercus (Fig. 1I, J) short, about half as long as its width in lateral view, sparsely or moderately setose. Spermatheca (Fig. 1K) ellipsoidal, 1.4–1.6 times as long as its greatest width, strongly sclerotized except narrow area at juncture to duct unsclerotized, with reticulate surface patterns near juncture as well as many fissures on most of other portions, and without internal hairs; both accessory ducts subequal in thickness to each other and also subequal to main duct.

Male. Body length 2.5–3.0 mm. **Head.** Slightly wider than thorax. Upper eye consisting of large facets in 14 horizontal rows and in 13 vertical columns. Clypeus brownish-black, thickly white pruinose, densely covered with

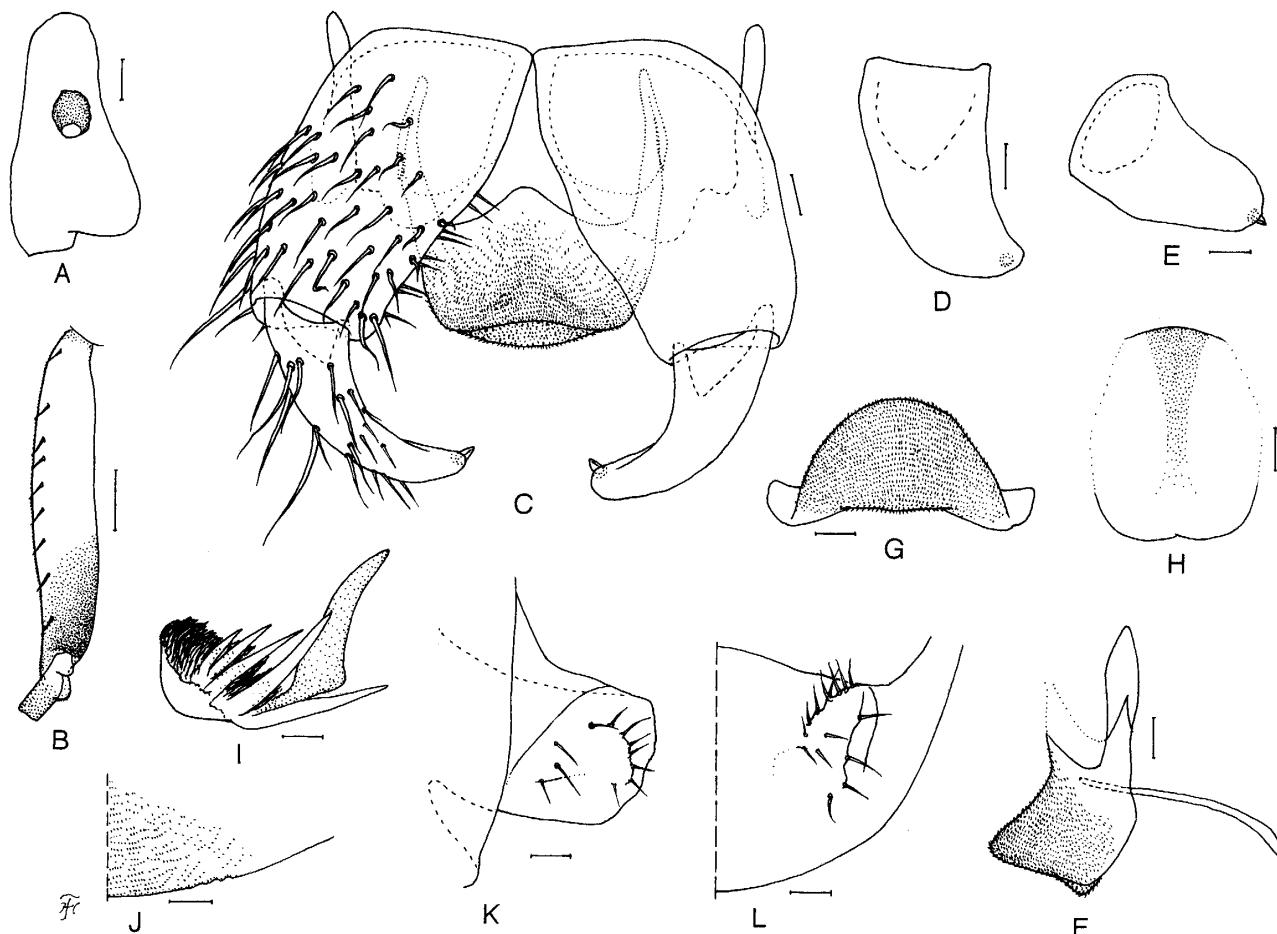


Fig. 2. Male of *Simulium (Gomphostilbia) floresense* sp. nov. A, 3rd segment of maxillary palp with sensory vesicle (right side, front view); B, hind basitarsus and 2nd tarsal segment (left side, outer view); C, coxites, styles and ventral plate *in situ* (ventral view); D and E, styles (D, ventrolateral view; E, end view); F, ventral plate and median sclerite (lateral view); G, ventral plate (end view); H, median sclerite (end view); I, paramere (left side, dorsal view); J, aedeagal membrane (end view); K and L, 10th abdominal segments and cerci (K, lateral view; L, end view). Scale bars. 0.1 mm for B; 0.02 mm for A and C–L.

yellow hairs interspersed with several dark hairs. Antenna composed of 2+9 segments, yellowish except 4 or 5 apical flagellar segments light brown; 1st flagellar segment elongate, 1.6–1.7 times as long as 2nd flagellar segment. Maxillary palp light to medium brown, with 5 segments, proportional lengths of 3rd, 4th, and 5th segments 1.0 : 1.1 : 3.1; sensory vesicle (Fig. 2A) small, 0.19 times as long as 3rd segment. **Thorax.** Nearly as in female. **Legs.** Color similar to that of female. Fore basitarsus slender, cylindrical, 8.9 times as long as its greatest width. Hind basitarsus (Fig. 2B) nearly parallel-sided from near base to apical 1/3, then narrowed toward apex, 4.94 times as long as wide, 0.63 times as wide as greatest widths of hind tibia and femur which are equal to each other; calcipala and pedisulcus well developed. **Wing.** Length 2.1–2.2 mm. Other features as in female except subcosta bare. **Abdomen.** Basal scale dark yellow, with fringe of yellow hairs. Dorsal surface of abdomen dark brown to brownish-black except basal 1/2 or more of 2nd segment yellow, and covered with dark and pale hairs; tergites 2, 5–7 each with shiny whitish-pruinoose patches dorsolaterally, and tergites 3 and 4 also slightly shiny at certain angle of light. **Genitalia.** Coxite in ventral view (Fig. 2C) subquadrate, 1.7 times as long as wide. Style in ventral view (Fig. 2C) shorter than coxite, curved inwardly, with stout apical spine having medial slit and directed dorsomedially; style in ventrolateral view (Fig. 2D) very slightly narrowed from base, then abruptly tapered near apex; style in end view (Fig. 2E) with rounded apex. Ventral plate in ventral view (Fig. 2C) lamellate, much wider than long, narrowed posteriorly, with posteroventral margin slightly concave but posterodorsal margin gently rounded, densely covered with minute setae on ventral and posterior surfaces, and with basal arms slightly diverged from base to a little beyond middle, then converged apically; ventral plate in lateral view (Fig. 2F) moderately raised ventrally and also posteriorly; ventral plate in end view (Fig. 2G) rounded ventrally. Median sclerite (Fig. 2H) weakly sclerotized medially, broad, plate-like, with rounded apex. Paramere (Fig. 2I) with 4 or 5 stout spines of different sizes (shortened from outer hook to inner one) and numerous smaller ones. Aedeagal membrane (Fig. 2J) moderately covered with minute setae, not or very weakly sclerotized near dorsal margin.

Ventral surface of 10th abdominal segment (Fig. 2K, L) without distinct hairs. Cercus (Fig. 2K, L) small, with 11–15 distinct hairs.

Pupa. Body length about 3.0 mm. **Head.** Integument (Fig. 3A) light yellow, moderately covered with round tubercles; antennal sheath normal, with no spinous projections and almost bare; frons with 3 pairs of simple very long trichomes and face with pair of simple very long trichomes. **Thorax.** Integument light yellow, moderately covered with round tubercles, with 3 pairs of simple very long trichomes anterodorsally, with 2 pairs of simple very long and long trichomes anterolaterally, with 1 pair of simple long trichomes posterolaterally, and with 3 pairs of simple trichomes (1 medium-long, 2 short) ventrolaterally. Gill (Fig. 3B) composed of 1 major thick and long filament (2.2–2.8 mm long), 2 triplets of slender short filaments (0.8–1.5 mm long) and 1 slender medium-long filament (1.2–2.0 mm long); 1st triplet nearest to base with very short to short stalk directed upward, 2nd triplet near 1st triplet with very short to short stalk directed inward, both triplets composed of 3 individual filaments arising at the same level (Fig. 3C) or 2 paired filaments with very short to short stalk and 1 individual filament (Fig. 3D); 1 remaining medium-long filament arising from inside surface of major filament somewhat apical to 2nd triplet and much longer than filaments of triplets but shorter than major filament; major filament (and often its counter inner filament) usually light yellowish-brown though paler apically and other filaments whitish-yellow throughout their lengths; major filament and single individual filament gradually tapered toward apical tip, with annular ridges and furrows though ridges less marked on basal portions and covered with minute tubercles, somewhat larger ones on ridges; 6 slender filaments of triplets very slightly narrowed from base toward apex, with weakly defined annular ridges and furrows, and covered with minute tubercles. **Abdomen.** Dorsally, segments 1 and 2 light yellow and not tuberculate; segment 1 with 1 simple slender medium-long seta on each side; segment 2 with 1 simple slender medium-long seta and 5 simple slender short setae submedially on each side; segments 3 and 4 mostly unpigmented, each with 4 hooked spines and 1 simple slender short seta on each side; segment 5 lacking spine-combs; segments 6–9 each with distinct spine-combs in trans-

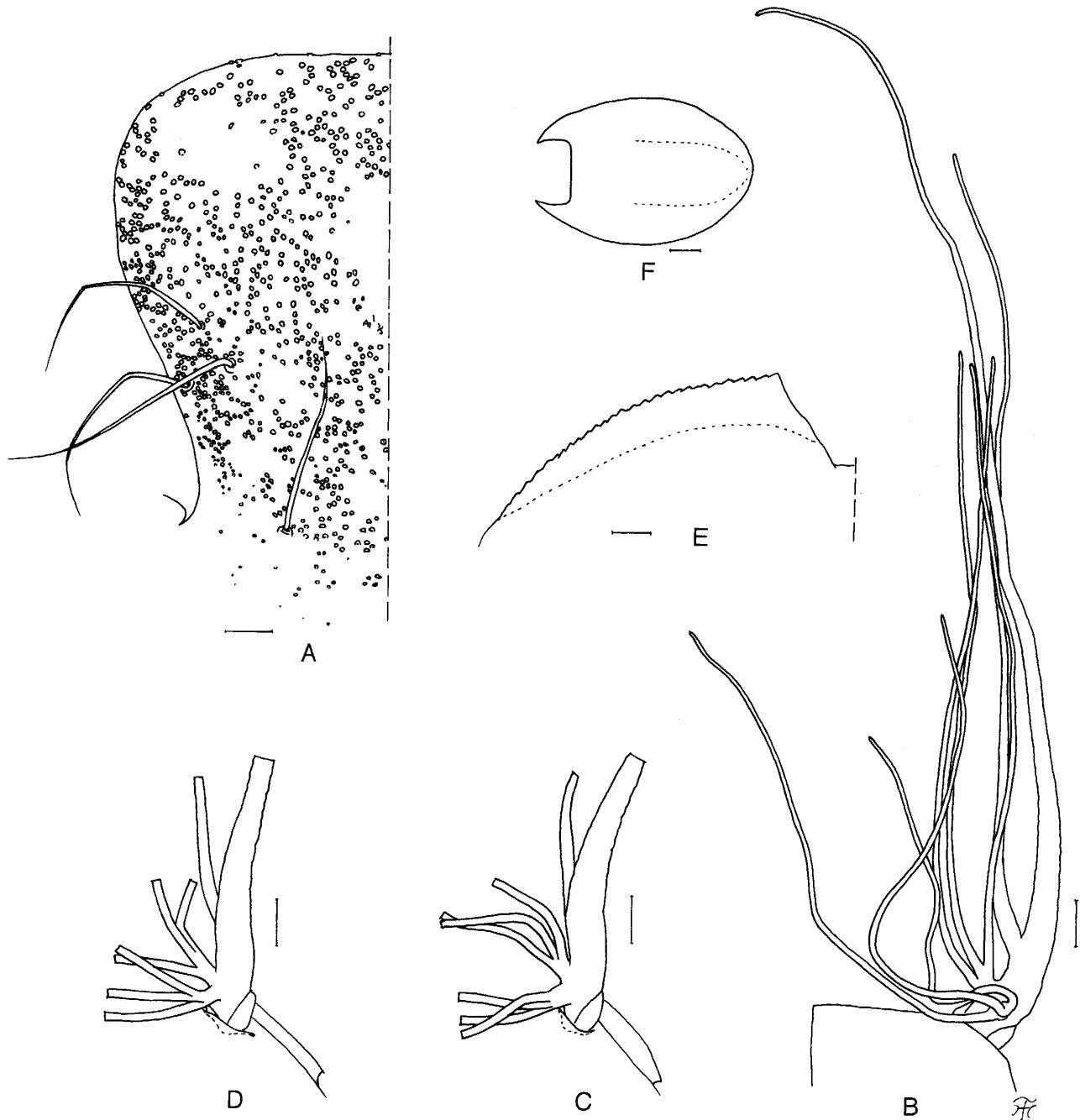


Fig. 3. Pupa of *Simulium (Gomphostilbia) floresense* sp. nov. A, head integument with 1 facial and 3 frontal trichomes (right half, front view); B, gill filaments (right side, dorsal view); C and D, basal portion of gill showing arrangement of 8 filaments (right side, outer view); E, terminal hook (left side, end view); F, cocoon (dorsal view). Scale bars. 0.05 mm for F; 0.1 mm for B, C and D; 0.05 mm for A; 0.01 mm for E.

verse row, together with comb-like groups of minute spines on each side; segment 9 not tuberculate, with pair of distinct broad terminal hooks moderately serrated on outer margin (Fig. 3E). Ventrally, segment 3 with a few simple slender minute setae; segment 4 with 1 simple or bifid medium-long hooklet and a few simple slender short setae on each side; seg-

ment 5 with pair of bifid or trifid hooks submedially and a few simple slender short setae on each side; segments 6 and 7 each with pair of bifid inner and simple or bifid outer hooks somewhat separated from each other, and a few simple slender short setae on each side. Each side of segment 9 with 3 grapnel-like hooklets. **Cocoon** (Fig. 3F). Wall-pocket-shap-

ed, moderately extending ventrolaterally, moderately woven though anterior margin strongly woven, without anterodorsal projection; posterior 1/2 with floor moderately woven; individual threads well visible; 2.8–3.9 mm long by 1.6–2.6 mm wide.

Mature larva. Body length 4.8–5.6 mm. Body dark greyish to greyish-brown. Head capsule appears faded in color making it difficult to judge whether head-spot patterns are positive or negative, though head-spots on cephalic apotome appearing faintly positive. Antenna composed of 3 segments and apical sensillum, longer than stem of labral fan; proportional lengths of 1st, 2nd and 3rd segments 1.0 : 1.0 : 0.7. Labral fan with 40–42 main rays. Mandible (Fig. 4A) with comb-teeth decreasing in size from 1st to 3rd teeth; mandibular serrations composed of 2 teeth (1 large, 1 small); larger tooth at acute angle to mandible on apical side; supernumerary serrations absent. Hypostoma (Fig. 4B) with row of 9 apical teeth; median tooth as long as each corner tooth, and slightly longer than 3 intermediate teeth on each side; lateral margins smooth; 4 (rarely 5) hypostomal setae lying nearly parallel to, or slightly divergent posteriorly from, lateral margins. Postgenal cleft (Fig. 4C) long, 3.7–6.8 times as long as postgenal bridge, pointed anteriorly, constricted at base. Thoracic cuticle bare. Pharate pupal gill (Fig. 4D) composed of yellowish-brown thick filament and its counter thinner filament, and 6 unpigmented slender

filaments arising basally. Abdominal cuticle bare except a few posterior segments sparsely covered with simple and branched (split into 2–4) minute slender setae dorsally, and both sides of anal sclerite down to base of ventral papillae densely covered with numerous colorless setae. Rectal scales indiscernible. Rectal organ of 3 compound lobes, each with 5 or 6 (rarely 7) finger-like and/or thumb-like secondary lobules. Anal sclerite of usual X-form, with anterior arms nearly as long as posterior ones, broadly sclerotized at base; no sensilla on basal junction area and posterior to posterior arms; accessory sclerite absent. Ventral papillae well developed. Posterior circlet with 88–92 rows of up to 17 hooklets per row.

TYPE SPECIMENS. Holotype female reared from pupa, collected from a slow-flowing stream (width 0.3 m, shaded, water temperature 18.0°C, altitude 1,060 m) in a forest, Waereno, near the town of Ruteng, Flores, 13.IX.1993. Paratypes: 4 females, 2 males, 6 pupal exuviae and 9 mature larvae, same data and date as those of holotype.

ECOLOGICAL NOTES. The pupae and larvae of this new species were taken from leaves and stalks of trailing grasses in a slow-flowing stream. This species was col-

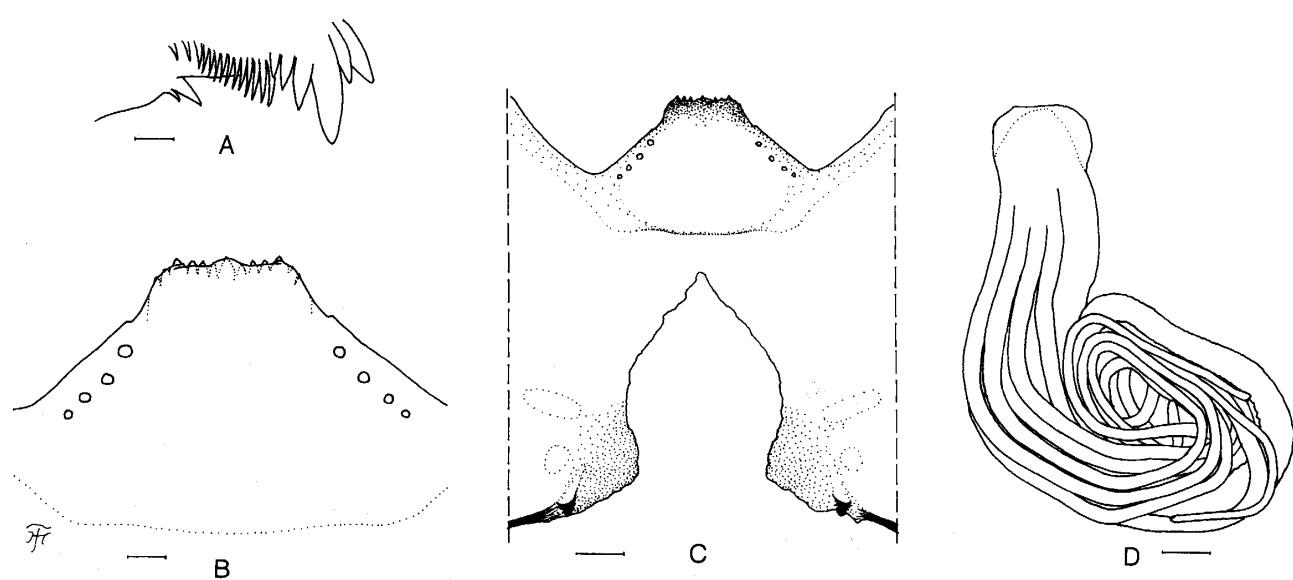


Fig. 4. Mature larva of *Simulium (Gomphostilbia) floresense* sp. nov. A, mandible; B, hypostoma; C, head capsule showing postgenal cleft (ventral view); D, pharate pupal gill (left side, outer view). Scale bars. 0.05 mm for C and D; 0.02 mm for B; 0.01 mm for A.

lected together with *S. (G.) brevilabrum* sp. nov. and *S. (G.) rutengense* sp. nov.

DISTRIBUTION. Flores.

ETYMOLOGY. The species name *flore-sense* refers to the island of Flores where this new species was collected.

REMARKS. This new species is assigned to the *batoense* species-group of the subgenus *Gomphostilbia* redefined by Takaoka (2003) by having the antenna composed of 2+9 segments, the pleural membrane bare in the female and male, and hind basitarsus not enlarged in the male.

This new species is characterized by the arrangement of the eight pupal gill filaments (Fig. 3B): i.e., the outer filament of the ventral pair is longer than its counter inner filament, which is longer than the other six filaments of triplets. The pupal gill of *S. (G.) mindanaoense* described from the Philippines by Takaoka (1983) is similar in the relative lengths of eight filaments to that of this new species but differs by the stalks of dorsal and middle triplets which are medium-long and only slightly thinner than the stalk of ventral paired filaments. Also, this new species is similar in both sexes of adults to *S. (G.) mindanaoense* in many features including the genitalia and leg colors, but is distinguished by the very narrow frons (frons-head ratio, 1:6.7 vs. 1:4.5) in the female, and the greater numbers of horizontal rows and vertical columns of large eye facets (14 and 13 vs. 11 and 11) in the male.

Simulium (Gomphostilbia) brevilabrum sp. nov.

DESCRIPTION. **Female.** Body length 2.2 mm. **Head.** Somewhat narrower than width of thorax. Frons (Fig. 5A) medium brown, not shiny, densely covered with yellowish-white scale-like recumbent hairs interspersed with several dark simple longer hairs along each

lateral margin; frontal ratio 1.95:1.00:3.64; frons-head ratio 1.00:5.95. Fronto-ocular area (Fig. 5B) well developed, directed somewhat upward. Clypeus medium brown, not shiny, thinly whitish-grey pruinose, densely covered with yellowish-white scale-like recumbent hairs interspersed with dark long curved hairs. Labrum short, 0.54 times as long as clypeus. Antenna composed of 2+9 segments, light to medium brown except scape, pedicel and base of 1st flagellar segment pale yellow. Maxillary palp composed of 5 segments, light to medium brown, proportional lengths of 3rd, 4th, and 5th segments 1.0:1.1:2.6; 3rd segment (Fig. 5C) somewhat swollen; sensory vesicle (Fig. 5C) oblong, 0.32 times as long as 3rd segment, with small opening apically. Maxillary lacinia with 12 or 13 inner and 15 outer teeth. Mandible with about 26 inner and 8 or 9 outer teeth though outer margin not toothed near apex. Cibarium (Fig. 5D) medially forming round sclerotized plate folded forward from posterior margin, and with well-sclerotized medial longitudinal ridge. **Thorax.** Scutum medium brown except anterolateral calli paler, with 3 faint dark narrow longitudinal vittae (1 medial and 2 submedial), shiny, thinly whitish pruinose, densely covered with yellowish-white scale-like recumbent hairs. Scutellum medium brown, covered with yellowish-white short hairs as well as dark long upright hairs along posterior margin. Postnotum medium brown, thinly white pruinose, bare. Pleural membrane bare. Katepisternum medium brown, longer than deep, moderately covered with yellowish-white hairs as well as dark hairs. **Legs.** Foreleg: coxa and trochanter whitish-yellow; femur light brown with apical 1/2 slightly darker; tibia white or yellowish-white on basal 3/4 and medium brown on apical 1/4; tibia densely covered with whitish fine hairs on outer surface of basal 3/4; tarsus medium brown, with moderate dorsal hair crest; basitarsus somewhat dilated, 5.8 times as long as its greatest width. Midleg: coxa dark brown; trochanter dark yellow; femur light to medium brown; tibia medium brown except basal 2/5 white or yellowish-white though white or yellowish-white portion extending up to apical 2/5 on posterior surface; tibia moderately covered with white fine hairs on posterior surface of basal 3/5; basitarsus medium brown except basal 1/3 of basitarsus yellow though its border not well defined. Hind leg: coxa light

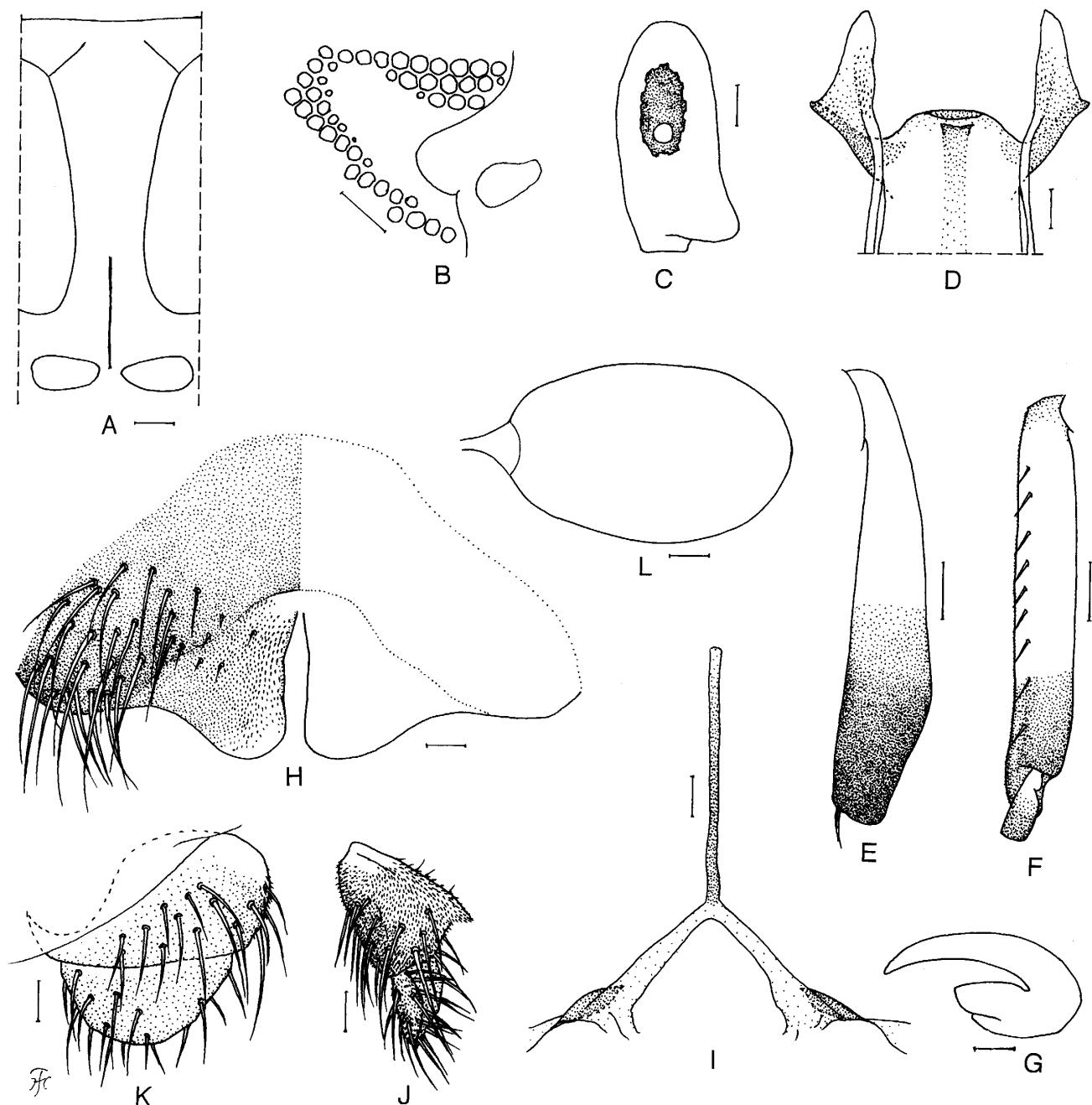


Fig. 5. Female of *Simulium (Gomphostilbia) brevilabrum* sp. nov. A, frons (front view); B, fronto-ocular area (right side; front view); C, 3rd segment of maxillary palp with sensory vesicle (right side, front view); D, cibarium; E, hind tibia (left side, outer view); F, hind basitarsus and 2nd tarsal segment (left side, outer view); G, claw; H, 8th sternite and ovipositor valves (ventral view); I, genital fork; J and K, paraprocts and cerci (right side; J, ventral view; K, lateral view); L, spermatheca. Scale bars. 0.1 mm for E and F; 0.05 mm for B; 0.04 mm for A; 0.02 mm for C, D and H-L; 0.01 mm for G.

brown; trochanter pale yellow; femur medium brown with base pale yellow and apical cap dark brown; tibia (Fig. 5E) white or yellowish-white on basal 1/2, light to dark brown on apical 1/2; tibia moderately covered with white fine hairs on posterior surface of basal 4/5; tibia moderately angulate posteriorly at apical 3/10 when viewed laterally; tarsus

medium brown except a little less than basal 3/4 of basitarsus and basal 1/3 of 2nd tarsal segment yellowish-white; basitarsus (Fig. 5F) narrow, nearly parallel-sided, 6.1 times as long as wide, and 0.74 and 0.61 times as wide as greatest widths of tibia and femur, respectively; calcipala 1.2 times as long as wide, and 0.76 times as wide as basitarsus. All femora, tibiae

and parts of tarsus moderately covered with dark (and also pale) scale-like hairs. Claw (Fig. 5G) with large basal tooth 0.5 times as long as claw. **Wing.** Length 2.5 mm. Costa with dark spinules as well as light brown hairs intermixed with pale hairs near base. Subcosta with dark hairs except near apex bare. Hair tuft on stem vein consisting of golden-yellow hairs (though basal portions of most hairs brownish). Basal portion of radial vein fully haired. R_1 with dark spinules as well as hairs; R_2 with hairs only. Basal cell absent. **Abdomen.** Basal scale dull ocherous or light brown, with fringe of pale hairs. Abdomen medium brown except basal 2/3 of segment 2 pale, moderately covered with dark short hairs; tergites of segments 2, 6-8 wide and shiny, while those of segments 3-5 narrow, nearly quadrate, subequal in shape and size to one another and all dull; ventral surfaces of segments 2-4 pale whitish-yellow to light brown, and those of other segments medium brown; sternal plate on segment 7 undeveloped. **Genitalia.** Sternite 8 (Fig. 5H) bare medially, with 24 or 25 long and medium-long stout hairs as well as a few short setae on each side. Ovipositor valves (Fig. 5H) nearly triangular, with round medioposterior corners, thin, membranous, moderately covered with microsetae interspersed with 2 short setae; inner margins gently concave, narrowly sclerotized, and somewhat separated from each other. Genital fork (Fig. 5I) of usual inverted-Y form, with arms of moderate width; arm moderately folded medially. Paraproct in ventral view (Fig. 5J) appearing triangular, and in lateral view (Fig. 5K) slightly protruding ventrally, with 16-18 long hairs on ventral and lateral surfaces, and with 4 or 5 sensilla on inside surface. Cercus in lateral view (Fig. 5K) 0.46 times as long as wide, rounded posteriorly, sparsely covered with hairs on outer surface. Spermatheca (Fig. 5L) ellipsoidal, about 1.6 times as long as wide, well sclerotized except duct and small area near juncture to duct unsclerotized, and with many fissures on surface; internal setae appear to be absent; both accessory ducts slender, subequal in diameter to each other and also subequal to major one.

Male. Body length 2.8 mm. **Head.** Slightly wider than thorax. Upper eye consisting of 11 vertical columns and 13 horizontal rows of large facets. Face medium brown, white pruinose. Clypeus medium brown, moderately

covered with yellowish-white scale-like hairs (mostly directed upwards) interspersed with several dark simple longer hairs on each side. Antenna composed of 2+9 segments, light brown except scape, basal 1/2 of pedicel and base of 1st flagellar segment pale; 1st flagellar segment elongate, about 1.7 times as long as 2nd flagellar segment, and apical segment about 1.5 times as long as 8th flagellar segment. Maxillary palp with 5 segments, light to medium brown, proportional lengths of 3rd, 4th, and 5th segments 1.0 : 1.2 : 3.0; sensory vesicle (Fig. 6A) small, nearly globular, and with very small opening. **Thorax.** Scutum medium brown except anterolateral calli paler, with 2 faint dark narrow longitudinal sub-medial vittae, somewhat shiny at certain angle of light, and thinly whitish pruinose on each shoulder, along each lateral margin and on prescutellar area; scutum densely covered with whitish-yellow scale-like recumbent hairs; other features as in female. **Legs.** Foreleg: coxa whitish-yellow; trochanter whitish-yellow with outer portion ocherous; femur light brown with apical 1/2 somewhat darker; tibia white or yellowish-white except apical 1/3 medium brown, and densely covered with white scale-like recumbent hairs on most of outer surface; tarsus medium brown, with moderate dorsal hair crest; basitarsus slightly dilated, 7.0 times as long as its greatest width. Midleg: coxa medium to dark brown; trochanter dark ocherous except basal 1/2 whitish-yellow; femur medium brown; tibia medium brown with basal 1/3 white, and moderately covered with white scale-like hairs on posterior and outer surfaces of basal 1/3 or a little more; tarsus medium brown except basal 1/3 of basitarsus whitish-yellow though its border not well defined. Hind leg: coxa light brown; trochanter whitish-yellow; femur medium brown with base whitish-yellow and apical cap dark brown; tibia (Fig. 6B) dark brown with a little more than basal 2/5 yellowish-white, and densely covered with white scale-like recumbent hairs on posterior and outer surfaces of basal 2/5; tarsus dark brown except a little less than basal 1/2 of basitarsus and base of 2nd tarsal segment yellowish-white; basitarsus (Fig. 6C) enlarged, wedge-shaped, gradually widened from base toward middle, then nearly parallel-sided, 3.3 times as long as wide, and 1.0 and 1.3 times as wide as greatest widths of tibia and femur, respectively; calcipala small,

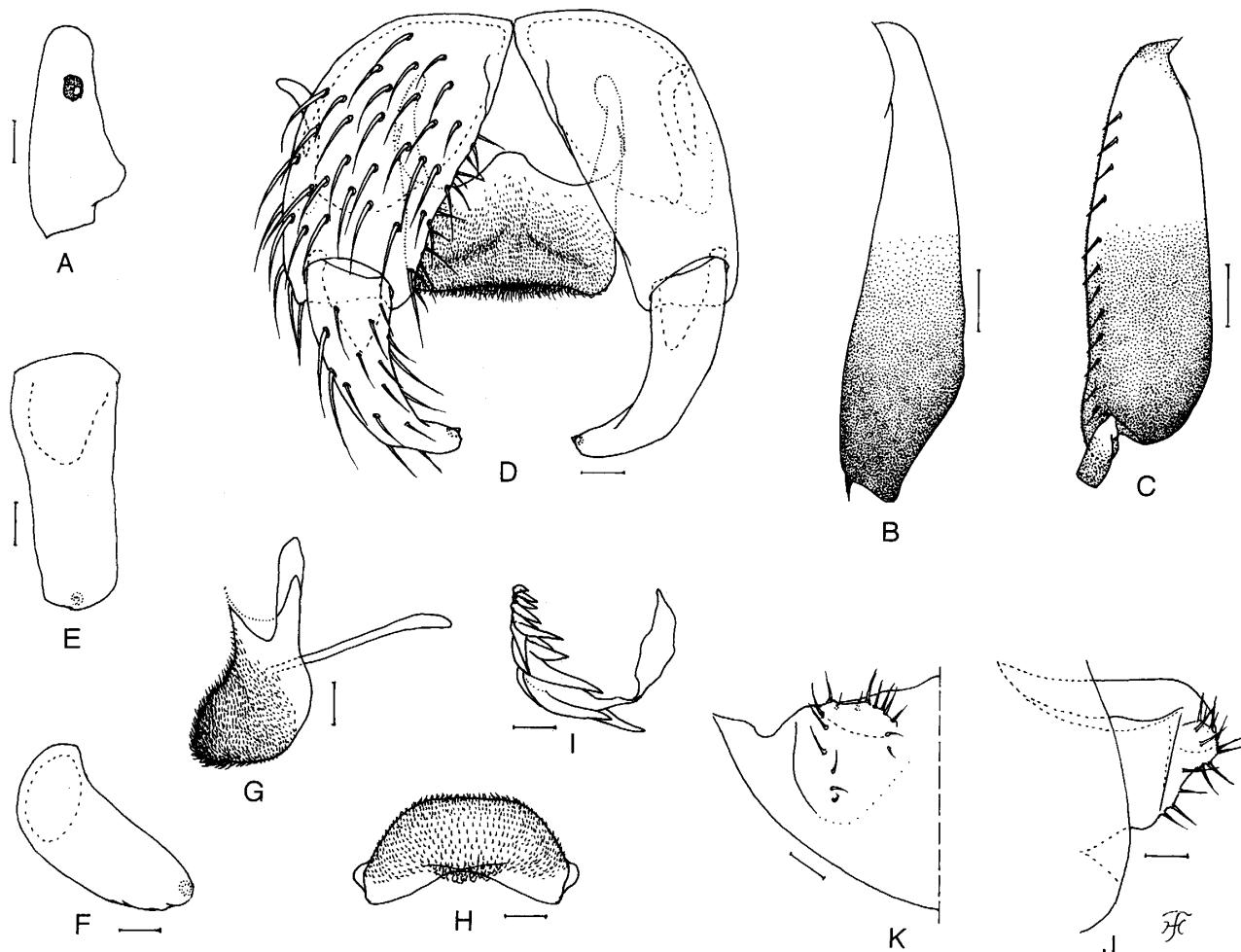


Fig. 6. Male of *Simulium (Gomphostilbia) brevilabrum* sp. nov. A, 3rd segment of maxillary palp with sensory vesicle (right side, front view); B, hind tibia (left side, outer view); C, hind basitarsus and 2nd tarsal segment (left side, outer view); D, coxites, styles and ventral plate *in situ* (ventral view); E and F, styles (E, ventrolateral view; F, end view); G, ventral plate and median sclerite (lateral view); H, ventral plate (end view); I, paramere (left side, dorsal view); J and K, 10th abdominal segments and cerci (J, lateral view; K, end view). Scale bars. 0.1 mm for B and C; 0.02 mm for A and D-K.

nearly as long as wide, and about 0.3 times as wide as greatest width of basitarsus. All femora, tibiae and parts of tarsus moderately or densely covered also with dark scale-like recumbent hairs. **Wing.** Length 2.1 mm; other features as in female except subcosta haired on basal 3/5. **Abdomen.** Basal scale medium brown, with fringe of light brown hairs. Dorsal surface of abdomen medium brown except basal 1/2 of 2nd segment somewhat paler, covered with dark hairs; segments 2, 5-7 each with pair of shiny dorsolateral patches, of which those on segment 2 broadly connected in middle to each other, and those on other segments narrowly connected to each other along anterior margin (tergites of segments 3 and 4 also with pair of slightly shiny submedial patches anteriorly at certain angle of light).

Genitalia. Coxite in ventral view (Fig. 6D) rectangular, about 1.8 times as long as wide. Style in ventral view (Fig. 6D) about 0.8 times as long as coxite, gently bent inward, gradually tapered toward apex and with small apical spine directed dorsomedially; style in ventrolateral view (Fig. 6E) very slightly narrowed toward apex; style in end view (Fig. 6F) with rounded apex with apical spine having median slit. Ventral plate in ventral view (Fig. 6D) transverse, much shorter than wide, nearly parallel-sided or slightly widened anteriorly, with posterior margin nearly straight or slightly convex medially, and densely covered with microsetae on ventral surface; basal arms of moderate length, somewhat diverged basally and then slightly converged; ventral plate in lateral view (Fig. 6G) moderately produced

ventrally; ventral plate in end view (Fig. 6H) rounded ventrally but almost straight near apex, and densely covered with microsetae on posterior surface. Median sclerite thin, plate-like, wide. Paramere (Fig. 6I) of moderate size, with 3 distinct long stout hooks and a few shorter ones close together near apex; aedeagal membrane sparsely setose, and dorsal plate indistinct. Ventral surface of 10th abdominal segment (Fig. 6J) without distinct hairs near posterior margin on each side. Cercus (Fig. 6J, K) rounded, with 14–16 short hairs.

Pupa. Body length 2.3–2.8 mm. **Head.** Integument (Fig. 7A) light yellow, densely covered with round tubercles; antennal sheath normal, with no spinous projections and almost bare; face with pair of simple very long trichomes, and frons with 3 pairs of simple very long trichomes; 3 frontal trichomes on each side arising somewhat close together. **Thorax.** Integument light yellow, densely covered with round tubercles, with 3 pairs of simple very long trichomes dorsally, with 2 pairs of simple very long trichomes anterolaterally, with 1 pair of simple medium-long trichomes postero-laterally, and with 3 pairs of simple trichomes (1 medium-long, 2 short) ventrolaterally. Gill (Fig. 7B, C, D) composed of 4 slender filaments arranged in pairs, lying vertically, somewhat

longer than pupal body, with somewhat swollen transparent organ ventrally (partially broken); stalk of ventral pair much longer than that of dorsal pair and subequal in length to common basal stalk; all filaments light yellowish-brown, gradually tapered toward apical tip, with annular ridges and furrows though ridges less marked on basal portions, and covered with minute tubercles, somewhat larger ones on ridges. **Abdomen.** Dorsally, segments 1 and 2 light yellow and moderately tuberculate; segment 1 with 1 simple slender medium-long seta on each side; segment 2 with 1 simple slender medium-long seta and 3–5 short somewhat spinous setae submedially on each side; segments 3 and 4 mostly unpigmented, each with 4 hooked spines and 1 short somewhat spinous seta on each side; segment 5 lacking spine-combs; segments 6–9 each with distinct spine-combs in transverse row, together with comb-like groups of minute spines on each side; segment 9 sparsely covered with minute tubercles (though bare in 1 pupa), with pair of distinct broad terminal hooks moderately serrated on outer margin (Fig. 7E). Ventrally, segment 3 with a few simple slender minute setae; segment 4 with 1 simple hook and a few simple slender minute setae on each side; segment 5 with pair of bifid hooks submedially and a few

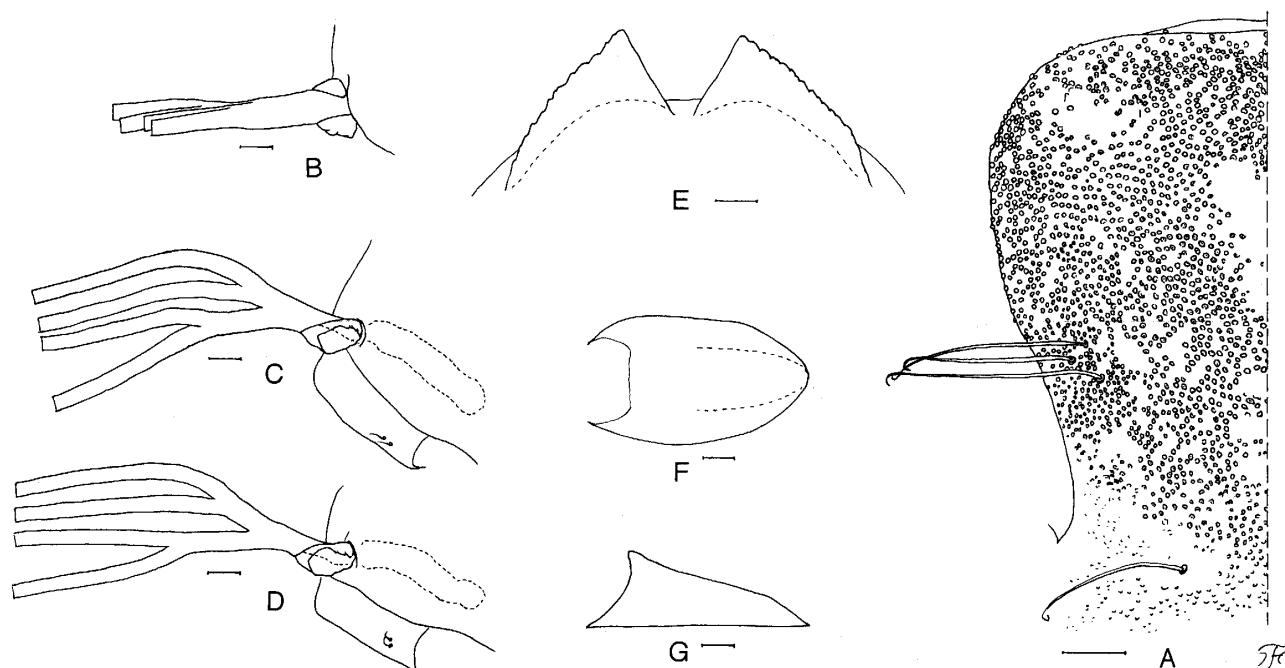


Fig. 7. Pupa of *Simulium (Gomphostilbia) brevilabrum* sp. nov. A, head integument with 3 frontal and 1 facial trichomes (right half, front view); B, C and D, basal portion of gill showing arrangement of 4 filaments (left side, B, dorsal view; C and D, outer view); E, terminal hooks (end view); F and G, cocoons (F, dorsal view; G, lateral view). Scale bars. 0.5 mm for F and G; 0.1 mm for A–D; 0.01 mm for E.

short simple slender setae on each side; segments 6 and 7 each with pair of bifid inner and simple or bifid outer hooks somewhat separated from each other, and a few simple short slender setae on each side. Each side of segment 9 with 3 grapnel-like hooklets. **Cocoon** (Fig. 7F, G). Wall-pocket-shaped, somewhat extending ventrolaterally, moderately woven (though anterior margin strongly woven), without anterodorsal projection; posterior 1/2 with floor moderately woven; individual threads well visible; 3.5 mm long by 2.0 mm wide.

Mature larva. Unknown.

TYPE SPECIMENS. Holotype female reared from pupa, same data and date as those of holotype of *S. (G.) floresense* sp. nov. Paratypes: 1 male, 1 pupal exuviae, same data and date as those of holotype.

ECOLOGICAL NOTES. The two pupae of this new species were taken from a leaf of trailing grass and a slender plant root in a slow-flowing stream. This species was collected together with *S. (G.) floresense* sp. nov. and *S. (G.) rutengense* sp. nov.

DISTRIBUTION. Flores.

ETYMOLOGY. The species name *brevilabrum* refers to the short labrum of the female of this new species.

REMARKS. *Simulium (G.) brevilabrum* sp. nov. is assigned to the *ceylonicum* species-group by the enlarged male hind basitarsus (Fig. 6C), and seems to be closely related to *S. mogii* and *S. gimpuense*, both described from Sulawesi (Takaoka, 2003), by having the pupal gill with four slender filaments (Fig. 7C, D). However, this new species differs in the female from these two known species in that it has a very narrow frons (frons-head ratio 1.00 : 5.95; Fig. 5A) and a short labrum (0.54 times as long as clypeus), while the latter two species have a wider frons (i.e., frons-head ratio 1.0 : 4.4 and 1.0 : 4.5, respectively) and a longer labrum (i.e., 0.97 and 0.94 times as long as clypeus, respectively). In

the male, *S. (G.) brevilabrum* is distinguished by the color of the hind tibia which is yellowish-white on a little more than basal 2/5 (Fig. 6B) (cf., white on the basal 1/3 in the two known species). The pupa of *S. (G.) brevilabrum* differs by the two filaments of each pair lying vertically (Fig. 7B) and ridges on the filaments not sharply defined (two filaments of each pair lying horizontally and ridges on the filaments sharply defined in the two known species).

***Simulium (Gomphostilbia) rutengense*
sp. nov.**

DESCRIPTION. **Female.** Unknown.

Male. Body length 2.5 mm. **Head.** Nearly as wide as thorax. Upper eye consisting of 11 vertical columns and 13 horizontal rows of large facets. Face medium brown, white pruinose. Clypeus medium brown, moderately covered with yellowish-white scale-like hairs (mostly directed upwards) interspersed with several dark simple longer hairs on each side. Antenna composed of 2+9 segments, ocherous to light brown except scape, pedicel and base of 1st flagellar segment pale; 1st flagellar segment elongate, 1.6 times as long as 2nd flagellar segment, and apical segment also elongate, 1.9 times as long as 8th flagellar segment. Maxillary palp with 5 segments, light to medium brown, proportional lengths of 3rd, 4th, and 5th segments 1.0 : 1.1 : 3.2; sensory vesicle (Fig. 8A) small, nearly globular and with very small opening. **Thorax.** Scutum medium brown except anterolateral calli lighter, with 3 dark narrow longitudinal vittae (1 medial, 2 sub-medial), somewhat shiny at certain angle of light, and thinly whitish pruinose on each shoulder, along each lateral margin and on prescutellar area; scutum densely covered with yellowish-white scale-like recumbent hairs. Scutellum medium brown, covered with dark short hairs as well as dark long upright hairs along posterior margin. Postnotum medium brown, thinly white pruinose, bare. Pleural membrane bare. Katepisternum medium brown, longer than deep, moderately covered with brassy hairs. **Legs.** Nearly as in male of *S. (G.) brevilabrum* except following characteristics: fore tibia white or yellowish-white except

a little more than apical 1/4 medium brown; fore basitarsus slightly dilated, 7.2 times as long as its greatest width; mid tarsus medium brown except a little more than basal 1/3 of basitarsus whitish-yellow though its border not well defined; hind basitarsus (Fig. 8B) 3.1 times as long as wide, and 1.0 and 1.2 times as wide as greatest widths of tibia and femur, respectively. **Wing.** Length 2.2 mm; Costa with dark spinules as well as light brown hairs intermixed with clear hairs near base. Subcosta with dark hairs except near apex bare. Hair tuft on stem vein consisting of dark hairs. Basal portion of radial vein fully haired. R_1 with dark spinules as well as hairs; R_2 with hairs only. Basal cell absent. **Abdomen.** Basal scale dark brown, with fringe of ocherous hairs. Dorsal surface of abdomen dark brown except those of 2nd and 3rd segments light brown though posterior 1/4 of tergite 3 dark

brown, covered with dark hairs; segments 2, 5–7 each with pair of shiny large dorsolateral patches, of which those on segment 2 broadly connected in middle to each other, and those on other segments narrowly to widely connected to each other along anterior margin (tergites of segments 3 and 4 also with pair of shiny patches at certain angle of light). **Genitalia.** Coxite in ventral view (Fig. 8C) rectangular, 1.7 times as long as wide. Style in ventral view (Fig. 8C) short, about 0.8 times as long as coxite, gradually tapered toward apex, gently curved inwardly, and with apical spine directed dorsomedially; style in ventrolateral view (Fig. 8D) slightly narrowed toward apex; style in end view (Fig. 8E) rounded apically, having apical spine with median slit. Ventral plate in ventral view (Fig. 8C) transverse, much shorter than wide, nearly parallel-sided, with posterior margin nearly straight or somewhat

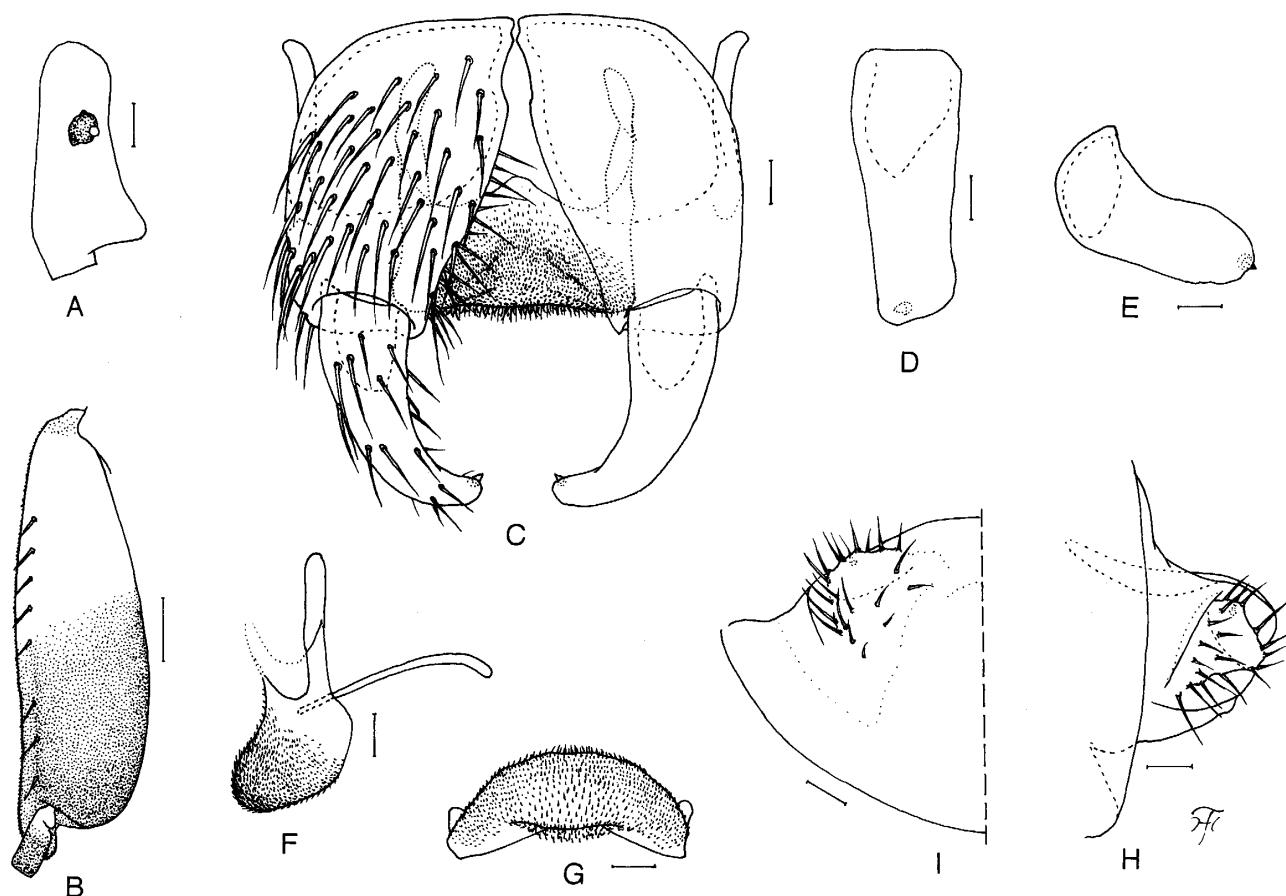


Fig. 8. Male of *Simulium (Gomphostilbia) rutengense* sp. nov. A, 3rd segment of maxillary palp with sensory vesicle (right side, front view); B, hind basitarsus and 2nd tarsal segment (left side, outer view); C, coxites, styles and ventral plate *in situ* (ventral view); D and E, styles (D, ventrolateral view; E, end view); F, ventral plate and median sclerite (lateral view); G, ventral plate (end view); H and I, 10th abdominal segments and cerci (H, lateral view; I, end view). Scale bars. 0.1 mm for B; 0.02 mm for A and C–I.

convex medially, and densely covered with microsetae on ventral surface; basal arms of moderate length, nearly parallel-sided, somewhat converged apically; ventral plate in lateral view (Fig. 8F) somewhat produced ventrally; ventral plate in end view (Fig. 8G), rounded ventrally and densely covered with microsetae on posterior surface. Median sclerite thin, plate-like, wide. Paramere of moderate size, each with 3 or 4 distinct long stout hooks and a few smaller ones close together near apex; aedeagal membrane sparsely setose; dorsal plate indistinct. Ventral surface of 10th abdominal segment (Fig. 8H) without distinct hairs near posterior margin on each side. Cercus (Fig. 8H, I) with 15–21 short hairs.

Pupa. Body length 3.2 mm. **Head** (Fig. 9A). Nearly as in *S. (G.) brevilabrum*. **Thorax.** As in *S. (G.) brevilabrum* except following characteristics: gill (Fig. 9B) composed of 8 slender filaments arranged in 3+3+2 filaments from

dorsal to ventral, lying vertically, probably as long as or somewhat longer than pupal body (all filaments cut off apically, then their length not measurable), with somewhat swollen transparent organ ventrally (partially broken); stalk of ventral pair slightly thicker than those of dorsal and middle triplets; ventral paired filaments subequal in thickness to each other, slightly thicker than 6 other filaments of triplets which are all subequal in thickness to one another; common basal stalk of moderate length, longer than stalks of ventral pair and dorsal and middle triplets, but shorter than interspiracular trunk; all filaments light yellowish-brown, gradually tapered toward apical tip, with distinct annular ridges and furrows though ridges less marked on basal portions, and covered with minute tubercles, somewhat larger ones on ridges. **Abdomen.** As in *S. (G.) brevilabrum* including dorsal surface of 9th segment sparsely covered with minute tubercles

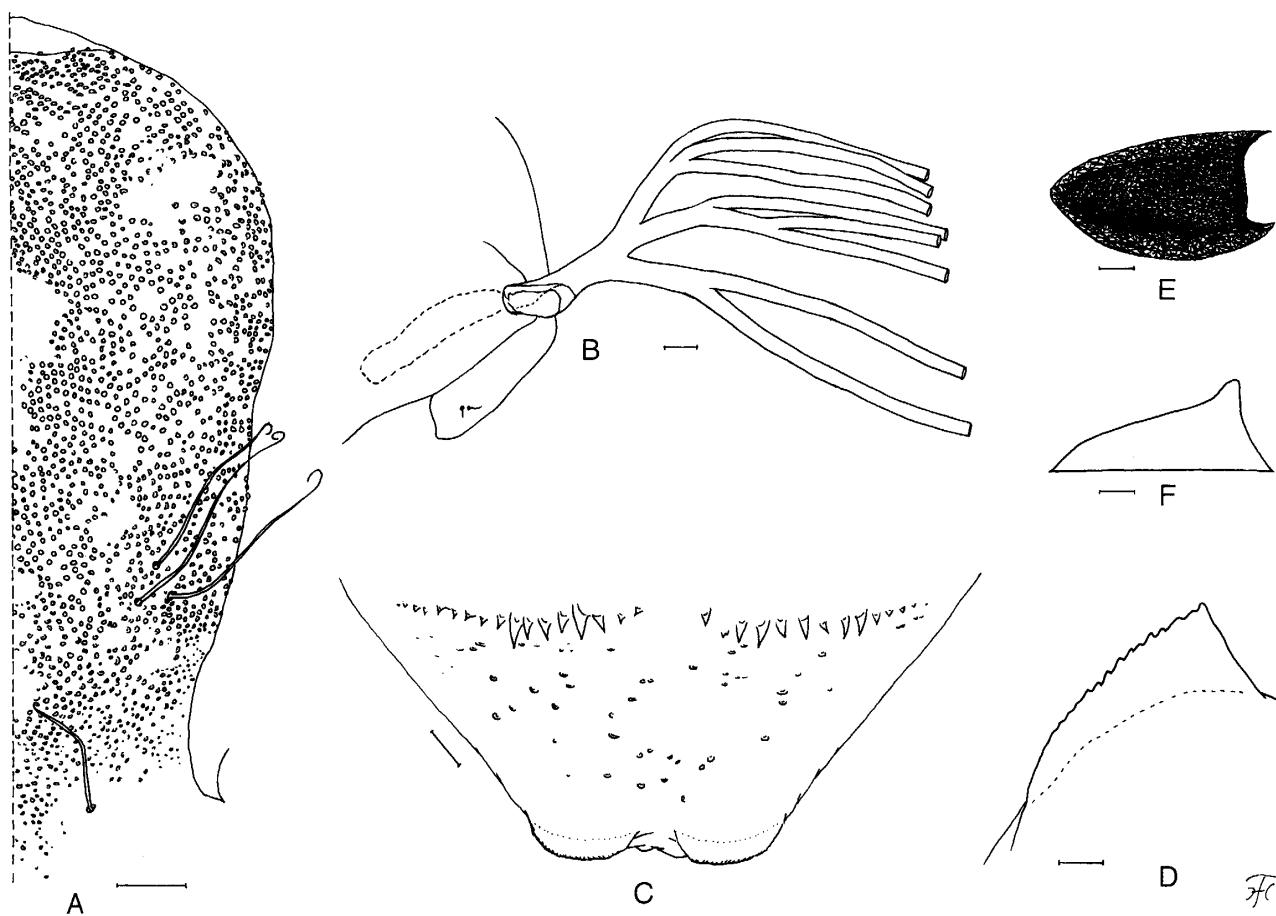


Fig. 9. Pupa of *Simulium (Gomphostilbia) rutengense* sp. nov. A, head integument with 3 frontal and 1 facial trichomes (right half, front view); B, basal portion of gill showing arrangement of 8 filaments (right side, outer view); C, 9th abdominal segment (dorsal view); D, terminal hook (left side, end view); E and F, cocoons (E, dorsal view; F, lateral view). Scale bars. 0.5 mm for E and F; 0.1 mm for A and B; 0.02 mm for C; 0.01 mm for D.

(Fig. 9C) and plate-like terminal hooks with moderately developed serrations on outer margin (Fig. 9D), though ventral surface of segment 5 with pair of bifid or trifid hooks on each side. **Cocoon** (Fig. 9E, F). Wall-pocket-shaped, somewhat extending ventrolaterally, moderately woven except anterior margin strongly woven, without anterodorsal projection though anterodorsal portion somewhat bulged; posterior 1/2 with floor moderately woven; individual threads well visible; 3.2 mm long by 2.0 mm wide.

Mature larva. Body length 5.6 mm. Body greyish to greyish-brown. Head capsule appears faded in color making it difficult to judge whether head-spot patterns are positive or negative. Antenna composed of 3 segments and apical sensillum, longer than stem of labral fan; proportional lengths of 1st, 2nd, and 3rd segments 1.0:0.8:1.0. Labral fan with 40 main rays. Mandible (Fig. 10A) with comb-teeth decreasing in size from 1st to 3rd teeth; mandibular serrations composed of 2 teeth (1 large, 1 small); larger tooth at acute angle to mandible on apical side; supernumerary serrations absent. Hypostoma (Fig. 10B) with row of 9 apical teeth; median tooth as long as each corner tooth, and slightly longer than 3 intermediate teeth on each side; lateral margins smooth; 4 or 5 hypostomal setae lying nearly parallel to lateral margins. Postgenal cleft (Fig. 10C) medium-long, 2.7 times as long as postgenal bridge, constricted at base. Pharate pupal gill composed of 8 slender filaments.

Thoracic cuticle bare. Abdominal cuticle bare except a few posterior segments very sparsely covered with short simple slender setae dorsally, and both sides of anal sclerite down to base of ventral papillae densely covered with numerous colorless setae. Rectal scales indiscernible. Rectal organ (Fig. 10D) of 3 compound lobes, each with 2 or 3 thumb-like secondary lobules. Anal sclerite of usual X-form, with anterior arms nearly as long as posterior ones, broadly sclerotized at base; no sensilla on basal juncture area and behind posterior arms; accessory sclerite absent. Ventral papillae well developed. Posterior circlet with 82 rows of up to 14 hooklets per row.

TYPE SPECIMENS. Holotype male with associated pupal exuviae and cocoon, same data and date as those of holotype of *S. (G.) floresense* sp. nov. Paratype: 1 mature larva, same data and date as those of holotype of *S. (G.) floresense* sp. nov.

ECOLOGICAL NOTES. The pupa and mature larva of *S. (G.) rutengense* sp. nov. were collected on grass leaves in a small shaded stream in a forest. Associated species were *S. (G.) brevilabrum* sp. nov. and *S. (G.) floresense* sp. nov.

DISTRIBUTION. Flores.

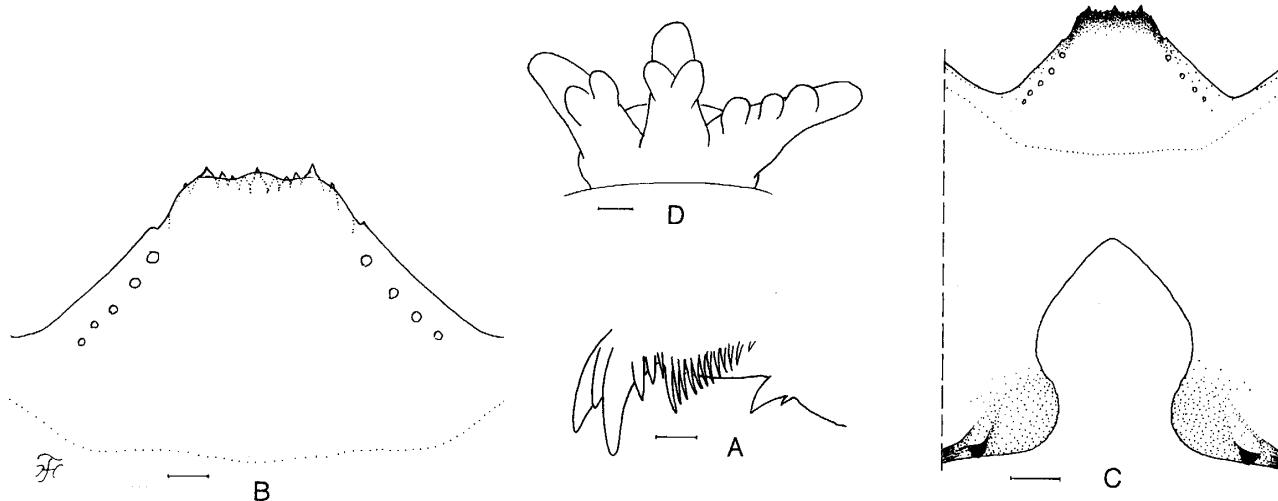


Fig. 10. Mature larva of *Simulium (Gomphostilbia) rutengense* sp. nov. A, mandible; B, hypostoma; C, head capsule showing postgenal cleft (ventral view); D, rectal organ (posteroventral view). Scale bars. 0.05 mm for C and D; 0.02 mm for B; 0.01 mm for A.

ETYMOLOGY. The species name *rutengense* refers to the town of Ruteng where this new species was collected.

REMARKS. The male of *S. (G.) rutengense* sp. nov. is distinctive in having a haired subcosta among the *ceylonicum* species-group to which this new species is assigned. In having this rare character as well as the pupal gill with eight filaments per side, this new species is similar to *S. (G.) asakoae* from Peninsular Malaysia and Thailand (Takaoka and Davies, 1995). However, there are differences in the following pupal and larval characteristics (those of *S. (G.) asakoae* in parentheses): common basal stalk of the pupal gill longer than the stalk of the ventral pair (Fig. 9B) (much shorter); dorsal surfaces of the pupal abdominal segments 1, 2 and 9 tuberculate (Fig. 9C) (not tuberculate); terminal hooks of the last pupal abdominal segment very wide (Fig. 9D) (not wide); larval rectal organ with 2 or 3 thumb-like secondary lobules per lobe (Fig. 10D) (8–10 finger-like secondary lobules per lobe).

***Simulium (Nevermannia) aureohirtum*
Brunetti**

Simulium aureohirtum Brunetti, 1911: 283–288 (male); Edwards, 1934: 134–137 (female, pupa and larva).

Simulium (Nevermannia) aureohirtum: Ogata, 1956: 61–62; Ogata, 1966: 129; Crosskey, 1987: 459; Takaoka and Roberts, 1988: 194–195; Crosskey and Lowry, 1990: 204; Takaoka and Davies, 1995: 87–88; Crosskey and Howard, 1997: 47; Takaoka, 2003: 37–45 (female, male, pupa and larva).

Simulium (Eusimulium) aureohirtum: Puri, 1933: 1–7; Ogata and Sasa, 1954: 325; Ogata, Sasa and Suzuki, 1956: 73; Crosskey, 1973: 423; Takaoka, 1976: 170–171; Takaoka, 1979: 382–384 (female, male, pupa and larva); Datta, 1983: 225; Takaoka and Suzuki, 1984: 11–12.

Eusimulium aureohirtum: Orii, Uemoto and Onishi, 1969: 1–13.

Simulium (Eusimulium) tuaranense Smart and Clifford, 1969: 40–43. Syn. by Crosskey 1973.

Simulium (Eusimulium) philippinense Delfinado

1962: 47–62. Syn. by Takaoka 1983.

SPECIMENS EXAMINED. 3 females, 1 male, 2 pupae, 4 pupal exuviae, 2 mature larvae and 13 immature larvae, collected from an irrigation channel (width 0.5–1.0 m, exposed to sun, water temperature 19.5°C, altitude 1,070 m) in a rice field, near the town of Ruteng; 1 mature larva and 2 immature larvae, collected from a stream (width 3 m, exposed to sun, altitude 1,050 m), Wae Locale, near the town of Ruteng; 1 female, 3 males, 1 pupa, 4 pupal exuviae, 3 mature larvae and 5 immature larvae, collected from a slow-flowing ditch (width 0.2 m, water temperature 17.0°C, exposed to sun, altitude 1,250 m), Waso, Ruteng; all in Flores and collection date, 12.IX.1993.

ECOLOGICAL NOTES. The pupae and larvae of this species were collected from trailing grasses in slow-flowing water-courses. Associated species were *S. (G.) sundaicum*, *S. (S.) nebulicola* and *S. (S.) timorensis* sp. nov.

This species was reported to be autogenous in several areas of Asian countries (Takaoka and Noda, 1979; Takaoka and Suzuki, 1984; Takaoka, 2003). This physiological trait has been confirmed in the population of Flores. All the four emerged females of *S. (N.) aureohirtum* kept alive with sugar solution had numerous mature eggs five days after their emergence.

DISTRIBUTION. Borneo, China, Flores (new record), Halmahera, India, Japan, Java, Peninsular Malaysia, Philippines, Sri Lanka, Sulawesi, Sumatra, Thailand and Taiwan.

REMARKS. This species is widely distributed in the Oriental Region and parts of the Palaearctic Region, and has been assigned to the *ruficorne* species-group by Crosskey (1969). The morphological characteristics of the male specimens obtained from Flores agree with the description of this species given by Takaoka (2003) in-

cluding the scutellum bearing golden-yellow long hairs in place of brown hairs. There is a slight difference in the shape of the style between the present specimens and the Indian type specimen. When viewed laterally and posteriorly, the styles of the present males are broad and appear to be boot-shaped with a subtriangular inner dorsal end, like those of other specimens collected from various localities in southeast Asian countries (Takaoka, 1979, 1983, 2003; Takaoka and Davies, 1995, 1996), whereas the type male has a broad and square-ended style, according to the description and illustration given by Edwards (1934).

***Simulium (Simulium) timorense*
sp. nov.**

DESCRIPTION. Female. Body length 2.0–2.3 mm. **Head.** Narrower than width of thorax. Frons black, shiny, with several dark stout hairs along lateral margins; frontal ratio 1.1–1.2 : 1.0 : 1.1–1.3; frons-head ratio 1.0 : 4.2–4.8. Fronto-ocular area (Fig. 11A) shallow, not deeply extended laterally. Clypeus black, shiny, whitish pruinose, silvery iridescent when illuminated, moderately covered with dark stout hairs except most of upper portion and narrow mediolongitudinal portion bare. Labrum 0.60–0.63 times as long as clypeus. Antenna composed of 2+9 segments, yellow or tawny with apical 2 flagellar segments blackish; flagellar segments 1–7 often brownish dorsally, becoming darker apically, with 2 or 3 apical segments blackish. Maxillary palp brownish, composed of 5 segments, proportional lengths of 3rd, 4th, and 5th segments 1.0 : 1.0 : 2.5; 3rd segment (Fig. 11B) not enlarged; sensory vesicle (Fig. 11B) of medium size, ellipsoidal, 0.25 times as long as 3rd segment, with medium-sized opening apically. Maxillary lacinia with 9–12 inner and 12 outer teeth. Mandible with 26–28 inner and 7–9 outer teeth. Cibarium (Fig. 11C) with dark strongly sclerotized posterodorsal margin, and armed with numerous well-developed tubercles. **Thorax.** Scutum brownish-black to black, shiny, thinly grey pruinose, not patterned, moderately covered with dark brown recumbent short hairs. Scutellum brownish-black, with dark long

hairs. Postnotum brownish-black, shiny, silvery iridescent when illuminated, without hairs. Pleural membrane bare. Katepisternum longer than depth, bare. **Legs.** Foreleg: coxa and trochanter pale yellow; femur dark yellow or tawny, gradually darkened toward apical end; tibia brownish-black, with large area of whitish sheen on outer surface; tarsus brownish-black, with moderate dorsal hair crest; basitarsus greatly dilated, 4.1 times as long as its greatest width. Midleg: coxa black; trochanter, femur and tibia brownish-black, tibia with large area of whitish sheen on posterior surface when illuminated; tarsus almost yellowish-white except apical tip of basitarsus, apical 1/2 of 2nd segment, and 3rd to 5th segments light brown. Hind leg: coxa brownish-black; trochanter yellowish-white; femur brownish-black except extreme base yellowish-white; tibia brownish-black, with large area of whitish sheen on posterior surface when illuminated; tarsus whitish except apical 1/3 of basitarsus, apical tips of 2nd and 3rd segments, and 4th and 5th segments medium to dark brown; basitarsus (Fig. 11D) parallel-sided, 5.7 times as long as wide, 0.65 and 0.56 times as wide as greatest widths of hind tibia and femur, respectively; calcipala well developed, nearly as long as wide and 0.45 times as wide as basitarsus; pedisulcus well developed. Claw (Fig. 11E) with small subbasal tooth. Outer surfaces of femora and tibiae of mid and hind legs densely covered with scale-like hairs as well as usual simple hairs. **Wing.** Length 1.6–1.7 mm; costa with dark spinules and hairs. Subcosta bare. Basal section of vein R bare; R₁ with dark spinules as well as a few dark hairs; R₂ with dark hairs only. Hair tuft of stem vein dark brown. Basal cell absent. **Abdomen.** Basal scale black, with fringe of dark hairs; dorsal surface of abdomen dark brown to brownish-black, with sparse dark hairs; 2nd segment with large whitish iridescent dorsolateral spots broadly connected to each other in middle; tergites 6–8 large and shiny. Ventral surface of segment 7 lacking sternal plate. **Genitalia.** Sternite 8 (Fig. 11F) well sclerotized, bare medially, with many long stout hairs as well as short slender hairs laterally on each side; sternite 8 markedly produced posteromedially and also somewhat ventrally, forming triangular submedian lobes with rounded apex, each lobe covered with many long and short hairs, folded dorsally

along inner and posterolateral margins and having narrow nearly transparent bare projection sharply pointed backwardly which extends beyond posterior tip of lobe; inner margins of lobes slightly concave, widely separated from each other. Ovipositor valves (Fig. 11F) much reduced, and discernible as narrow membranous area connected to each posterolateral margin of sternite 8. Genital fork (Fig. 11G) of inverted-Y form, with long well-sclerotized stem; arms slender, each with strongly sclerotized distal ridge having short projection directed anterodorsally. Paraproct (Fig. 11H) well sclerotized, much produced ventroposteriorly slightly beyond level of ante-

rior margin of cercus, with numerous long hairs ventrally and posteriorly; ventral surface narrow, not plate-like but rounded; antero-medial surface with 5–9 sensilla; paraproct in lateral view (Fig. 11I) subtriangular, 0.74 times as long as wide. Cercus in lateral view (Fig. 11J) short, subquadrate or rounded posteriorly, covered with several short hairs. Spermatheca (Fig. 11K) ovoidal, well sclerotized except duct and large area near juncture to duct unsclerotized, with weakly and irregularly defined surface patterns and with minute internal setae; both accessory ducts subequal in diameter to each other and also subequal to main duct.

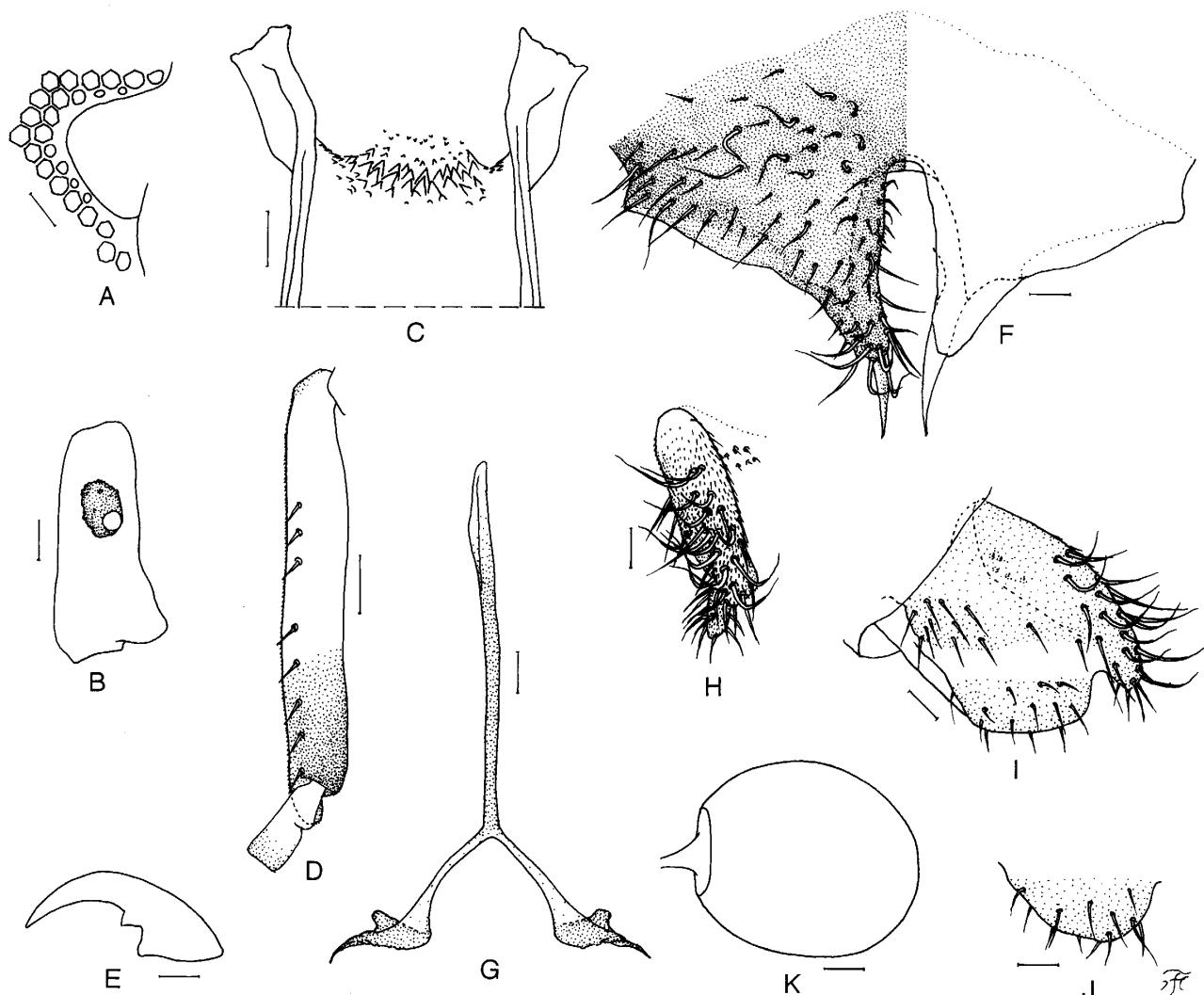


Fig. 11. Female of *Simulium (Simulium) timorense* sp. nov. A, fronto-ocular area (right side; front view); B, 3rd segment of maxillary palp with sensory vesicle (right side, front view); C, cibarium; D, hind basitarsus and 2nd tarsal segment (left side, outer view); E, claw; F, 8th sternite and ovipositor valves (ventral view); G, genital fork; H and I, paraprocts and cerci (right side; H, ventral view; I, lateral view); J, cercus (lateral view); K, spermatheca. Scale bars. 0.1 mm for D; 0.03 mm for A; 0.02 mm for B, C and F-K; 0.01 mm for E.

Male. Body length 2.2–2.6 mm. **Head.** Much wider than thorax. Upper eye consisting of large facets in 13 or 14 horizontal rows and 13 or 14 vertical columns. Clypeus black, whitish pruinose, strongly iridescent when illuminated, bare medially but covered with dark brown hairs along lateral margins. Antenna composed of 2+9 segments, yellow with apical 2 flagellar segments black; 1st flagellar segment elongate, 1.6–1.8 times as long as 2nd flagellar segment. Maxillary palp composed of 5 segments, proportional lengths of 3rd, 4th, and 5th segments 1.0 : 1.0 : 2.4; 3rd segment (Fig. 12A) not enlarged, with small globular sensory vesicle 0.12 times length of 3rd segment. **Thorax.** Scutum broadly white pruinose (silvery iridescent when illuminated) with inverted V-shaped black band at certain angles of light discon-

nected anteriorly leaving 2 broad black bands each slanting across scutum from anteromedial portion to wing base; scutum moderately covered with brown recumbent scale-like short hairs. Scutellum brownish-black, with dark long upright hairs. Postnotum brownish-black, white pruinose, bare. Pleural membrane and katepisternum as in female. **Legs.** Color of legs and shape of scale-like hairs on outer surface of femora and tibiae as in female; fore basitarsus dilated, 5.5 times as long as its greatest width; hind basitarsus (Fig. 12B) parallel-sided, 6.3 times as long as wide, 0.59 and 0.54 times as wide as greatest widths of hind tibia and femur, respectively; calcipala well developed, nearly as long as wide, 0.45 times as wide as basitarsus; pedisulcus well marked. **Wing.** Similar to that of female. **Abdomen.** Basal

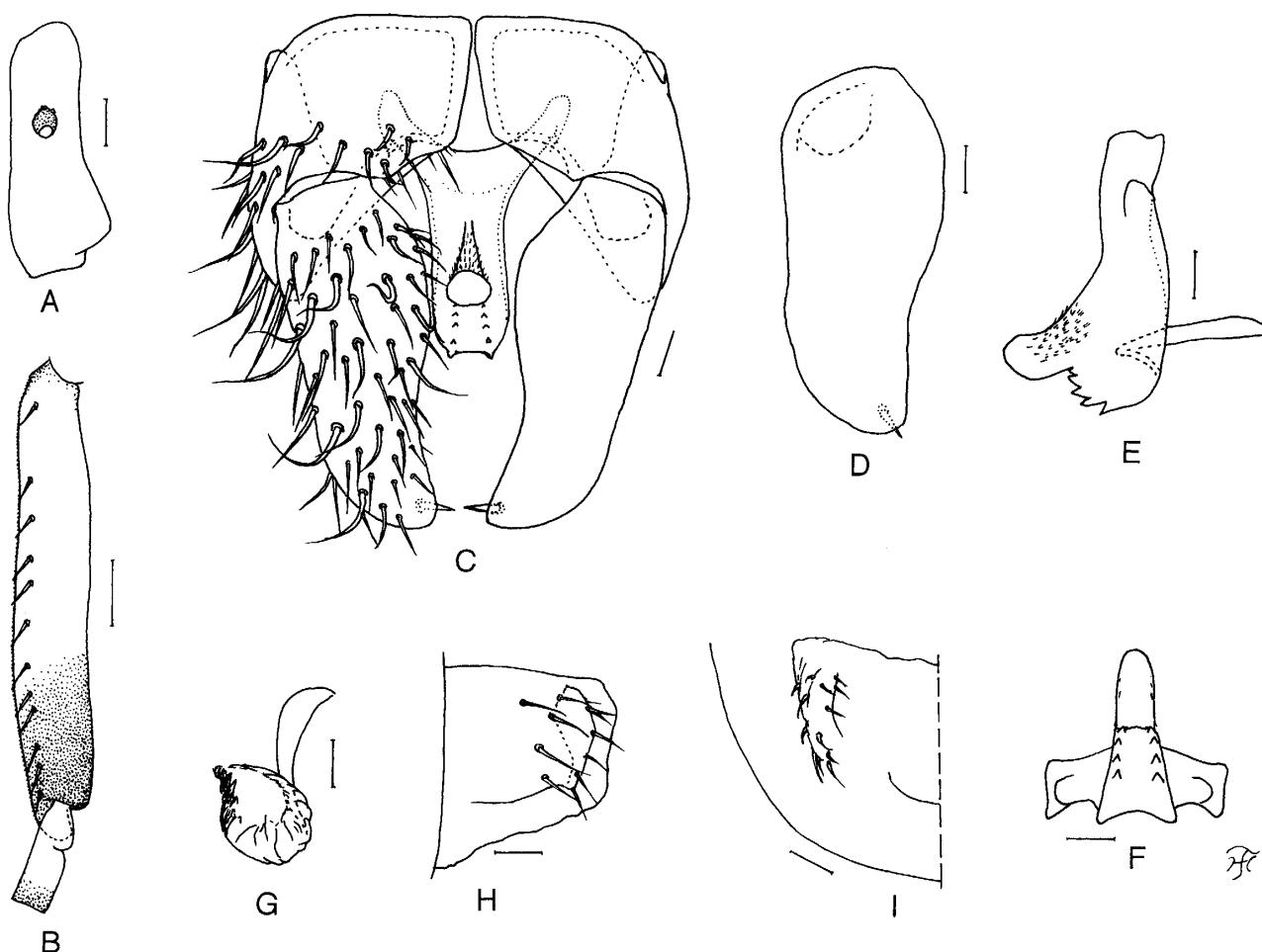


Fig. 12. Male of *Simulium (Simulium) timorense* sp. nov. A, 3rd segment of maxillary palp with sensory vesicle (right side, front view); B, hind basitarsus and 2nd tarsal segment (left side, outer view); C, coxites, styles and ventral plate *in situ* (ventral view); D, style (ventrolateral view); E, ventral plate and median sclerite (lateral view); F, ventral plate (end view); G, paramere (left side, ventral view); H and I, 10th abdominal segments and cerci (H, lateral view; I, end view). Scale bars. 0.1 mm for B; 0.02 mm for A and C–I.

scale blackish, with dark long hairs. Dorsal surface of abdomen black, with dark hairs; segments 2, 4-7 each with pair of silvery iridescent spots dorsolaterally, those on segment 2 connected broadly in middle. **Genitalia.** Coxite in ventral view (Fig. 12C) nearly quadrate on ventral surface, with dorsolateral tip extending posteriorly beyond base of style. Style in ventral view (Fig. 12C) elongate, 1.2 times as long as coxite, widened from base to basal 1/3, then gradually narrowed toward apex, with apical spine; style in ventrolateral view (Fig. 12D) widest at basal 1/3, 0.45 times length of style; style in lateral view flattened ventrodorsally, without basal protuberance. Ventral plate in ventral view (Fig. 12C) with elongate base 2.5 times as long as wide, rounded posteriorly, and with short stout arms diverged from each other; ventral plate in lateral view (Fig. 12E) much raised ventrally beyond dentate portion forming thumb-like median process covered with minute setae moderately on anterior and lateral surfaces but very sparsely on posterior surface, and bare on ventral tip, and with dentate posterior margin;

ventral plate in end view (Fig. 12F) bearing 2 rows of 5-7 sharp teeth on posterior surface of basal portion. Median sclerite simple, narrow, plate-like, slightly widened apically. Paramere (Fig. 12G) elongate basally, rounded apically and with several small hooks apically. Aedeagal membrane appearing bare, without sclerotized dorsal plate. Ventral surface of 10th abdominal segment (Fig. 12H) without distinct hairs. Cercus (Fig. 12H, I) small, with 12-15 distinct hairs.

Pupa. Body length (excluding gill filaments) 2.2-2.6 mm. **Head.** Integument (Fig. 13A) dark yellow, unevenly covered with minute tubercles on frons and face; antennal sheaths smooth; frons with 2 medium-long simple trichomes somewhat separated from each other and face with 1 medium-long simple trichome on each side. **Thorax.** Integument dark yellow, unevenly covered with minute tubercles (very sparsely on most of anterodorsal surface, moderately on peripheral areas and on postero-dorsal area), with 9 medium-long or short simple trichomes (3 dorsomedially, 2 anterolaterally, 1 posterolaterally, 3 ventrolateral-

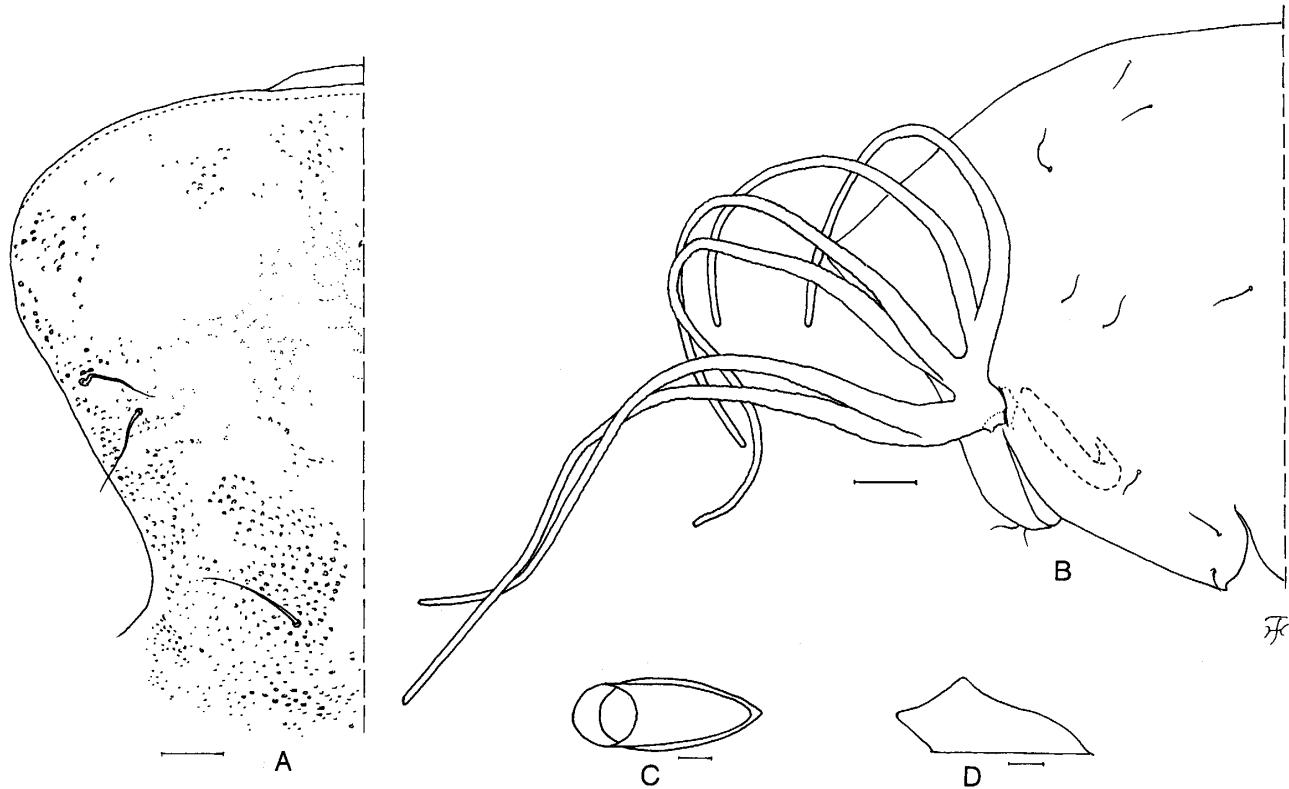


Fig. 13. Pupa of *Simulium (Simulium) timorense* sp. nov. A, head integument with 1 facial and 2 frontal trichomes (right half, front view); B, anterior portion of thorax and gill filaments (left side, outer view); C and D, cocoons (C, dorsal view; D, lateral view). Scale bars. 0.5 mm for C and D; 0.1 mm for B; 0.05 mm for A.

ly) on each side (Fig. 13B). Gill (Fig. 13B) with 6 slender thread-like filaments in 3 pairs; dorsal and ventral pairs with short stalk and middle pair sessile or with very short stalk; all filaments tapered apically, increasing in length and thickness from dorsal to ventral pairs: i.e., inner filament (about 1.2 mm long) of ventral pair longest of all, slightly longer than outer one (about 1.1 mm long) of the same pair, inner filament (about 1.0 mm long) of middle pair slightly longer than outer one (about 0.9 mm long) of the same pair, and 2 filaments (about 0.8 mm long) of dorsal pair subequal to each other and shortest; when compared basally, inner filament of ventral pair thickest, 1.1 times as thick as outer filament of the same pair, 2 filaments of middle pair subequal to each other, slightly thinner than outer filament of ventral pair but slightly thicker than outer filament of dorsal pair which is 1.2 times as thick as inner filament of dorsal pair which is thinnest, about 0.7 times as thick as thickest inner filament of ventral pair; cuticle of filaments with numerous transverse ridges and furrows sharply edged for the most part but weakly edged basally, densely covered with minute tubercles. **Abdomen.** Dorsally, seg-

ment 1 weakly sclerotized, yellowish, smooth, with 1 medium-long simple slender seta on each side; segment 2 transparent, smooth, with 1 medium-long seta and 5 short simple spinous setae on each side; segments 3 and 4 each with 4 hooked spines and 1 short simple slender seta on each side; segments 6 and 7 lacking spine-combs; segment 8 with spine-combs together with comb-like groups of minute spines in transverse rows and 2 short simple slender setae on each side; segment 9 lacking spine-combs and terminal hooks. Ventrally, segment 4 with 1 short simple spinous seta and a few short simple slender setae on each side; segment 5 with pair of bifid hooks close together submedially on each side; segments 6 and 7 each with pair of bifid or simple inner and simple outer hooks widely spaced on each side; segments 4-8 each with comb-like groups of minute spines. Grapnel-like hooklets absent. **Cocoon** (Fig. 13C, D). Shoe-shaped, light to dark brown, tightly woven, slightly to moderately extending ventrolaterally; opening directed upward and forward, with thick margin; individual threads invisible; 2.5-3.2 mm long by 1.0-1.4 mm wide.

Mature larva. Body length 3.7-4.3 mm.

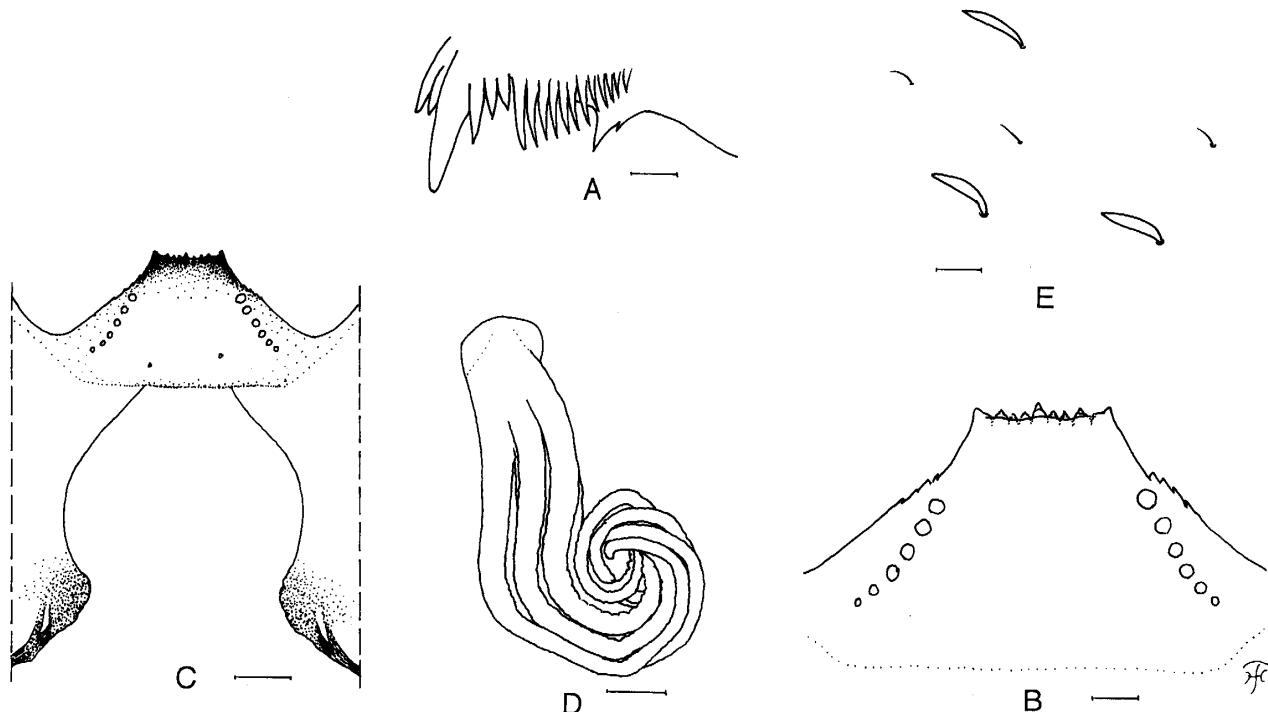


Fig. 14. Mature larva of *Simulium (Simulium) timorensis* sp. nov. A, mandible; B, hypostoma; C, head capsule showing postgenal cleft (ventral view); D, pharate pupal gill (left side, outer view); E, spatulate scales and minute setae on dorsal surface of a few posterior segments of abdomen. Scale bars. 0.05 mm for C and D; 0.02 mm for B; 0.01 mm for A and E.

Body color dark grey to brown. Color patterns of head capsule variable: cephalic apotome more or less darkened partially or entirely on posterior 2/5, darkest submedially between an terolateral and posterolateral spots and medially just in front of posterior margin, but entirely whitish-yellow with indistinct head spots in some larvae. Antenna composed of 3 segments and apical sensillum, longer than stem of labral fan; proportional lengths of 1st, 2nd and 3rd segments 1.0 : 1.1 : 0.6–0.7. Labral fan with about 44 main rays. Mandible (Fig. 14 A) with comb-teeth decreasing in size from 1st to 3rd; mandibular serration with 2 teeth (1 large, 1 small); large tooth at right angle to mandible on apical side; supernumerary serrations absent. Hypostoma (Fig. 14B) with 9 apical teeth; median tooth subequal in length to each corner tooth, and slightly longer than intermediate teeth on each side; lateral margins serrate apically; 6 or 7 hypostomal bristles per side, slightly diverging posteriorly from lateral border on each side. Postgenal cleft (Fig. 14C) very deep, apex reaching posterior border of hypostomium. Thoracic cuticle bare. Pharate pupal gill (Fig. 14D) with 6 slender filaments. Abdominal cuticle bare except a few posterior segments sparsely covered with spatulate setae and simple minute setae on dorsal and dorsolateral surfaces (Fig. 14E), and both sides of anal sclerite sparsely covered with colorless short setae. Rectal scales indistinct. Rectal organ of 3 compound lobes, each with 4–6 finger-like secondary lobules. Anal sclerite X-shaped, with broadened anterior arms about 0.7 times as long as posterior ones; 4–7 sensilla just posterior to posterior arms but no sensilla on basal juncture area; accessory sclerite absent. Last abdominal segment bulged laterally but lacking ventral papillae. Posterior circlet with 88–96 rows of hooklets with up to 18 hooklets per row.

TYPE SPECIMENS. Holotype female reared from pupa, collected in a moderately flowing stream about 100 m down from the spring (width about 2.0 m, depth about 0.2 m, water temperature 27.0°C, partially shaded, altitude 150 m), Baumata, Kupang, Timor, 11.IX.1993. Paratypes: 4 females, 5 males, 4 pupal exuviae and 1 mature larva and 7 immature larvae, same data and date as those of holotype; 18

females, 24 males, 6 pupae, 20 pupal exuviae, 13 mature larvae and 23 immature larvae, collected from a river (width 10–20 m, water temperature 22.0°C, exposed to sun, altitude 890 m), Waegarit, Ruteng, Flores, 12.IX.1993; 2 pupal exuviae, 2 mature larvae and 1 immature larva, collected from a small irrigation ditch (width about 0.2 m, exposed to sun, water temperature 17.0°C, altitude 1,250 m), Waso, Ruteng, Flores, 12.IX.1993; 1 immature larva, collected from a small stream (width 0.5–1.0 m, water temperature 19.5°C, exposed to sun, altitude 1,070 m) flowing in rice field, near the town of Ruteng, Flores, 12.IX.1993.

ECOLOGICAL NOTES. The pupae and larvae of this new species were found on trailing grasses, fine plant roots and twigs in streams. *Simulium (S.) timorense* sp. nov. was the only species collected in the stream of the type locality of Timor but this new species was collected together with *S. (N.) aureohirtum*, *S. (G.) sundaicum*, *S. (S.) upikae*, and *S. (W.)* sp. in a river and a few streams in Flores.

DISTRIBUTION. Flores and West Timor.

ETYMOLOGY. The species name *timorense* refers to Timor Island where this new species was collected for the first time.

REMARKS. *Simulium (S.) timorense* sp. nov. is very similar in the female, male and pupal stages to *S. nobile* De Meijere, originally described from Java (De Meijere, 1907) but is easily distinguished from the latter in the larval stage by lacking paired dorsal protuberances on the abdominal segments 1–5. This new species appears to be related to *S. (S.) leytenense* Takaoka from Leyte Island, Philippines (Takaoka, 1983) in that both species have a similar number of large eye facets of the male as well as the six filamented pupal gill, but this new species is distinguished by

having spatulate setae (Fig. 14E) on the dorsal surface of the larval abdomen.

Simulium (Simulium) nebulicola
Edwards

Simulium (Simulium) nebulicola Edwards, 1934: 114–115 (male); Takaoka and Davies, 1996: 71–75 (female, male, pupa and larva); Takaoka et al., 2000: 164.

SPECIMENS EXAMINED. 3 females, 7 males, 15 pupal exuviae, 3 mature larvae and 13 immature larvae, collected from a small irrigation ditch (width about 0.2 m, exposed to sun, water temperature 17.0°C, altitude 1,250 m), Waso, Ruteng; 2 immature larvae, collected from an irrigation channel (width 0.5–1.0 m, exposed to sun, water temperature 19.5°C, altitude 1,070 m) in a rice field, near the town of Ruteng; 17 mature larvae and 51 immature larvae, collected from a small stream (width 1.0 m, water temperature 17.0°C, shaded, altitude 1,430 m), Waces, Ruteng; all in Flores and collection date, 12.IX.1993.

ECOLOGICAL NOTES. The pupae and larvae were found on leaves and stalks of grasses trailing in the water of small streams. Associated species were *S. (G.) sundaicum*, *S. (N.) aureohirtum*, *S. (S.) timorense* sp. nov. and *S. (S.) upikae*.

DISTRIBUTION. Java, Flores (new record) and Sumatra.

REMARKS. The specimens from Flores agree with the description of *S. (S.) nebulicola* given by Takaoka and Davies (1996) except following characteristics: the female hind tibiae are dark on the apical half, the male large eye facets are in 18 horizontal rows and 16 vertical columns, and the male mid tibiae are almost dark except basal 2/5 white on the posterior surface.

Simulium (Simulium) upikae
Takaoka and Davies

Simulium (Simulium) upikae Takaoka and Davies, 1996: 54–57 (female, male, pupa and larva).

SPECIMENS EXAMINED. 1 female, 1 male, 1 pupa and 5 mature larvae, collected from a river (width 10–20 m, water temperature 22.0°C, exposed to sun, altitude 890 m), Waegarit, Ruteng; 1 male, 2 pupae, 2 pupal exuviae and 2 mature larvae, collected in a small stream (width 1.0 m, water temperature 17.0°C, shaded, altitude 1,430 m), Waces, Ruteng; all in Flores and collection date, 12.IX.1993.

ECOLOGICAL NOTES. The pupae and larvae of this species were found to be attached to the surface of stones and trailing grasses in a river and streams. Associated species were *S. (G.) sundaicum*, *S. (S.) nebulicola* and *S. (S.) timorense* sp. nov. and *S. (W.)* sp.

DISTRIBUTION. Java and Flores (new record).

REMARKS. The specimens collected from Flores mostly agree with the original description of *S. (S.) upikae* given by Takaoka and Davies (1996) in many key characteristics including the genitalia of both sexes of adults, the female sensory vesicle with a large opening, the male hind basitarsus apparently narrower than hind tibia, the shoe-shaped cocoon with a high anterior collar. However, it should be noted that several features are different between the specimens of Flores and Java as follows (characteristics of Javanese specimens in parentheses): in the female, the height of frons against the narrowest portion is 0.95 (1.12), number of minute tubercles of the cibarium is about 26 (about 7); in the male, the length of the hind basitarsus against its greatest width is 4.5 (4.0); in the pupa, two filaments of the lowest pair is subequal in thickness to

other filaments (1.5 times as thick as others) and slightly shorter than other filaments (0.5 or 0.6 times as long as other filaments).

This species was already assigned to the *eximum* species-group which is endemic to the Sunda Archipelago (Takaoka and Davies, 1996).

Simulium (Wallacellum) sp.

DESCRIPTION. Female, Male and Pupa. Unknown.

Mature larva. Body length 5.2 mm. Body normal in shape, somewhat swollen on thoracic segments, narrow on abdominal segments 1–4 (though slightly larger posteriorly), swollen from segment 5 to segment 6, and narrowed toward posterior end; body color greyish, with dark reddish-brown broad transverse band (disconnected dorsomedially and ventrally) each on abdominal segments 1–4. Cephalic apotome yellow with distinct dark head-spots. Cervical sclerite composed of 2 narrow rod-like pieces, not fused to occiput, widely separated medially from each other. Antenna composed of 3 segments and apical sensillum, longer than stem of labral fan; proportional lengths of 1st, 2nd, and 3rd segments 1.0 : 1.0 : 0.9. Labral fan with 39 main rays; dorsalmost ray having different pectination from that of other main rays. Mandible with comb-teeth decreasing in size from 1st to 3rd; mandibular serrations composed of 2 teeth (1 large, 1 small); large tooth at right angle to mandible on apical side; supernumerary serrations absent. Hypostoma with 9 apical teeth in row; median tooth slightly longer than each corner tooth; median tooth of 3 intermediate teeth on each side shortest; lateral margin serrate; 8 hypostomal bristles per side, lying nearly parallel to, or slightly diverging posteriorly from, lateral margin. Postgenal cleft medium-long, hanging-bell-shaped, with narrow anteromedian extension. Thoracic cuticle bare. Pharate pupal gill with 4 slender filaments arising at base. Abdominal cuticle almost bare, though a few simple colorless minute setae present on dorsal surface of each segment, and numerous simple colorless setae present on each side of anal sclerite of last segment. Rectal scales present. Rectal organ of 3 simple lobes, without secondary lobules. Anal sclerite X-shaped, with anterior

arms broadened and bifurcated apically when viewed from side, and 0.7 times as long as posterior ones; basal juncture area with small unsclerotized median portion posteriorly; 4 sensilla on basal juncture area and 1 sensillum behind each posterior arm; accessory sclerite absent. Last abdominal segment expanded ventrolaterally forming large ventrolateral bulge and smaller ventral bulge on each side, the latter visible as a small ventral papilla when viewed from side. Posterior circlet with 108 rows of up to 18 hooklets per row.

SPECIMEN EXAMINED. 1 mature larva, collected in a river (width 10–20 m, exposed to sun, water temperature 22.0°C, altitude 890 m), Waegarit, Ruteng, Flores, 12.IX.1993.

ECOLOGICAL NOTES. The larva of this species was collected attached to a grass leaf trailing in the water, together with *S. (G.) sundaicum*, *S. (S.) timorense* sp. nov. and *S. (S.) upikae*.

DISTRIBUTION. Flores.

REMARKS. A single mature larva collected from Flores is easily assigned to the subgenus *Wallacellum* defined by Takaoka (1983) in that it has the pharate pupal gill with four slender short filaments, the medium-sized postgenal cleft with narrow anterior extension, the simple rectal organ, and the small ventral papillae. This larva is similar to that of *S. (W.) celebensense* Takaoka reported from Sulawesi (Takaoka, 2003) but differs in the colored pattern of the abdomen, the possession of sensilla on the basal juncture area of the anal sclerite, and the number of hooklet rows of the posterior circlet. This species remains unidentified since its adults and pupa are not known yet.

This is the first record of this subgenus from the Sunda Archipelago.

BIOGEOGRAPHY

The simuliid fauna of Flores has been found to be essentially Oriental and not Australasian although the island is geographically close to the Australian continent. This is concluded from the present result that it lacks the subgenus *Morops* Enderlein, a main component of the simuliid fauna of the Australasian Region (Takaoka, 2003). Flores seems to be most closely related faunistically to Java. Four of the nine species found in Flores are also known to be distributed in Java, of which two species, i.e., *S. (S.) upikae* and *S. (S.) nebulicola*, are noteworthy to represent the *eximium* species-group and the unnamed species-group, respectively, both of which are endemic to the Sunda Archipelago. The relationship of the fauna of Flores to that of Sulawesi is also suggested by the facts that the species of the *ceylonicum* species-group with four pupal gill filaments per side have been found only in these two islands (Takaoka, 2003), and that the subgenus *Wallacellum*, which has been known to exist only in Yonakuni Island, Lan-Yu Island, the Philippines, Sulawesi, Seram Island and Biak Island, was found in Flores although represented by only one larva.

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